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Forest Vegetation of the White River National Forest in Western Colorado: A Habitat Type Classification

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Abstract

A vegetation classification based on concepts and methods developed by Daubenmire was used to identify eleven forest habitat types in the White River National Forest. Included were five habitat types in the *Populus tremuloides* series, two in the *Abies lasiocarpa* series, and one each in the *Pseudotsuga menziesii*, *Pinus edulis*, *Picea pungens*, and *Quercus gambelii* series. A key to identify the habitat types and the management implications associated with each is provided.

Cover Photo.—Climax forest of the *Abies lasiocarpa/Vaccinium scoparium* habitat type on the Holy Cross District. This stand has a basal area of 357 square feet per acre (82 m²/ha) and is more than 300 years old.

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Forest vegetation on the White River National Forest and adjacent areas has been studied previously to a limited extent, but this study comprehensively categorizes and describes forest habitat types based on quantitative data. Many earlier studies of forest vegetation were management-oriented or autecologic in scope, but a few are relevant to the present study. In a recently completed phyto-edaphic study, Hess and Wasser² described and classified grassland, shrubland, and forestland vegetation on the White River and Arapaho National Forests. Although the sampling methods and nomenclature differ from the study reported here, it is evident that at least eight of the habitat types described in this paper were observed. Adjacent to the White River to the north, Hoffman and Alexander (1980) described 11 habitat types on the Routt National Forest. Seven of these also occur on the White River. Further north, on the Medicine Bow National Forest in southern Wyoming, Wirsing and Alexander (1975) described five habitat types. Three of these also occur on the White River. On the Gunnison National Forest to the south, Langenheim (1962) described several biotic communities in the Crested Butte area, which appear from general descriptions to be similar to two of the habitat types on the White River.

This cooperative study was started in 1979 to (1) identify and describe the forest habitat types in the White River National Forest on the basis of both reconnaissance and intensively sampled plots well distributed over the whole Forest, (2) relate the habitat types to soils and climatic data, (3) describe successional patterns of forest vegetation, and (4) relate White River forest habitat types to other Rocky Mountain forests with similar classifications. The habitat type classification³ completed in 1982 is based on concepts and methods developed by Daubenmire and Daubenmire (1968), Hoffman and Alexander (1976), Hoffman and Alexander (1980), Pfister et al. (1977), and Steele et al. (1981).

The results reported here are intended for two primary audiences: forest managers and land use planners, who want a working tool to use on the White River National Forest, and ecologists, who want a research tool to use in related studies. Not all readers will find each category of information of equal value.

²Hess, Karl, and Clinton H. Wasser. *Grassland, shrubland, and forestland vegetation associations on the White River-Arapaho National Forests*, 335 p. Unpublished report on file at Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo. (FS-RM-MFRWU-1252).

³Hoffman, George R. *A classification of forest habitat types on the White River National Forest*, 123 p. Unpublished report on file at Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo. (FS-RM-MFRWU-1252).

STUDY AREA

Physiography and Geology

The White River National Forest in western Colorado (fig. 1) lies within the Southern Rocky Mountain Province described by Fenneman (1931). The northern part of the Forest is located on the Colorado Plateau, a large, early erosional surface formed by uplift and subsequent peneplanation. It is bounded on the north by the Green River Basin, on the west by the Uinta Basin, and on the south and east by the Colorado River. The northern segment of the Plateau is a large area of late tertiary andesitic and basaltic remnants of volcanic activity which form the Flattops. From the Flattops to the Colorado River south and east, the central and southern segments of the Plateau are characterized by level to rolling topography severely dissected by streams and rivers that form deep canyons, some of which are 2,000 feet (610 m) below the top of the Plateau. In these segments, the Plateau is composed of Paleozoic sedimentary deposits of limestone, sandstone, and siltstone underlain by Precambrian granites and schists. The Park-Gore Ranges form the backbone of the northeastern White River National Forest. This area is bounded on the north by Middle Park, to the east by the Blue River, to the south by the Mosquito Range, and to the west by the Colorado River. Structurally these ranges resemble the Front Range to the east. Both the Park and Gore Ranges are faulted anticlines with Precambrian igneous cores. However, prominently edged and upturned sedimentary rock layers on the western flank of the Gore Range are in sharp contrast to the physiography of the eastern flank of the Park Range where fewer resistant sedimentary rock layers remain. The southern White River National Forest, south of the Colorado River and west of the Gore and Mosquito Ranges, is comprised of two major mountain systems. The Sawatch Range, a massive faulted anticline intruded by Precambrian igneous rocks, dominates the southeastern part of the Forest. On the northern end and along the western flank of the Sawatch Range, including Red Table Mountain, red shales, siltstones, limestones, sandstones, and conglomerates predominate at middle and lower elevations. The Elk and West Elk Mountains are westward continuations of the Sawatch Range and characterize the southwestern White River National Forest. However, these ranges are not faulted anticlines. They are composed of Paleozoic sedimentary layers thrust westward over one another and highly metamorphosed. The Maroon Bells in the southern Elk Mountains are an example of highly metamorphosed sandstones and shales.



Figure 1.—The White River National Forest showing locations of study areas and current designated wilderness areas.

Climate

Precipitation in the White River National Forest increases with elevation. Mean annual precipitation varies from about 20 to 25 inches (51 to 64 cm) at 8,500 feet (2,590 m) in the *Populus tremuloides* forest zone to about 35 to 40 inches (89 to 102 cm) at 10,000 feet (3,050 m) in the *Abies lasiocarpa* forest zone. At these elevations, somewhat more than one-half of the total precipitation falls as snow during the six coldest months of the year.

Mean annual temperature in the *Populus tremuloides* forest zone is about 41° F (5° C), with a January mean of

23° F (−5° C) and a July mean of 61° F (16° C). In the *Abies lasiocarpa* forest zone, mean annual temperature is about 34° F (1° C), with a January mean of 18° F (−8° C) and a July mean of 55° F (13° C).

The limited temperature and precipitation data from published records are useful in characterizing the White River National Forest in broad, general terms. However, in regions with massive mountain ranges, deep valleys and canyons, and high plateaus, precipitation and temperatures are so variable that it is difficult to provide any meaningful climatic information for a given locality.

METHODS

Preliminary work began in 1979 with a reconnaissance survey of about 150 sites throughout the White River National Forest. At each site, plants present were listed, their abundance was noted, successional status of the stand and dominant tree species were estimated, possible habitat types were listed, and study sites noted, with a brief description of physiographic and edaphic factors.

During the summers of 1980 and 1981, 51 stands were intensively sampled. These stands were mostly old-growth and climax or in the late seral stages of succession. Old-growth stands were not available in every locality because of extensive past disturbance by fire, insects, logging, and grazing. Stands were representative of the forest communities characterized by the following tree species: *Populus tremuloides*, *Pseudotsuga menziesii*, *Pinus contorta*, *Abies lasiocarpa*, and *Picea engelmannii*.

In each stand, a 49.2- by 82.0-foot (15- by 25-m) plot was laid out with the long dimension parallel to contour. It was located in the most homogeneous part of the stand and away from ecotones and other disturbances. Each main plot was then subdivided into three 16.4- by 82.0-foot (5- by 25-m) subplots. Within each 4,036-square-foot (375-m²) main plot, all trees taller than 3.28 feet (1 m) were measured and recorded by 0.328-foot (1-dm) diameter classes. Trees less than 3.28 feet (1 m) tall were counted and recorded in two 3.28- by 82.0-foot (1- by 25-m) transects along the inner sides of the central subplot.

Canopy coverage of all understory shrubs, forbs, and graminoids was estimated in fifty 7.9- by 19.7-inch (2- by 5-dm) microplots placed systematically along the inner sides of the central subplot. Canopy coverage of each species was recorded as one of six coverage classes (1-5%, 6-25%, 26-50%, 51-75%, 76-95%, and 96-100%). Also listed were those species not occurring in the 50 microplots but present in the 4,036-square-foot (375-m²) main plot.

Finally, 25 cores representing the upper decimeter of the mineral soil were collected from each stand. These samples were air dried in the field, then were composited for laboratory analysis.

ANALYSIS OF DATA

Tree-size class data were combined according to habitat type, and mean values for each size class in each habitat type are recorded (table A-1).

For each microplot examined, the midpoints of the coverage classes were used to calculate average percent coverage for each shrub, graminoid, and forb species. Frequency, the percentage of microplots in which a species occurs in each stand, was also determined for each species. Coverage and frequency data for all understory species plus site data are shown in appendix tables A-2 through A-6. Species coverage and selected stand characteristics were then transferred to

an association table. Stands were arranged and rearranged to group stands with similar floristic composition and climax tree species. Habitat type separation was based on a consideration of both overstory and major shrubs, graminoids, and forbs (Daubenmire 1952, Daubenmire and Daubenmire 1968, Mueller-Dombois and Ellenberg 1974).

Soil texture was determined by a modified Bouyoucos method (Moodie and Koehler 1975). Other soil characteristics determined were pH (using a glass electrode on the saturated soil paste), cation exchange capacity, and exchangeable Ca, Mg, and K on the ammonium acetate extract. N by the Kjeldahl method, OM by a modified Walkley-Black method, and P by the Bray technique were also determined for each sample (Moodie and Koehler 1975).

Nomenclature for plants collected in this study follows Harrington (1954) and Weber (1976). Although plants were collected at various times during the growing season, some taxonomic difficulties persisted. Most of these resulted from hybridization among two or more species which have not been studied systematically to clarify the taxonomy. Other taxonomic difficulties related to lack of flowering specimens. Where considerable variation made it impossible to determine species, genera only were used.

ECOLOGIC TERMS AND CONCEPTS

Because terminology in ecology is not uniformly used or understood, the terms and concepts used in this paper are defined. Unless stated otherwise, all terms follow usage proposed by Daubenmire and Daubenmire (1968).

"Climax vegetation" is that which has attained a steady state with its environment; without disturbance, species of climax vegetation successfully maintain their population sizes. The following classification of climax vegetation was first proposed by Tansley (1935). Daubenmire (1968) further elaborated on the definition, usage, and limitations. Primary climaxes develop on habitats where recurring disturbance is not a factor influencing the structure or composition of the vegetation. "Climatic climax" vegetation develops on normal topography with fairly deep, well-drained, loamy soil. Normal topography in mountainous regions is necessarily different from that of plains regions. The absence of recurrent disturbance is also critical in defining climatic climax vegetation. Where soils or topography exert sufficient influence to produce self-perpetuating vegetation distinct from the climatic climax, the terms "edaphic climax" and "topographic climax," respectively, are used to describe the steady-state vegetation. Where special topographic conditions also favor the development of edaphic conditions distinct from the normal, the term "topo-edaphic climax" is often used in descriptions of the resulting steady-state vegetation.

Where recurring disturbance, such as grazing or fire, exerts a predominant influence on the composition or structure of steady-state vegetation the term "dis-

climax" is used. Two common disclimaxes are the "zootic climax" and the "fire climax." In the absence of the disturbing factor, or factors, it is possible the vegetation will revert to the primary climax.

Habitat type is the basic unit in classifying lands or sites based on potential (climax) natural vegetation. A habitat type represents, collectively, all parts of the landscape that support, or have the potential of supporting the same climax vegetation. Series is the next higher category of classification (Hoffman and Alexander 1976); each habitat type is named for its (climax) plant association. For example, all habitat types with *Pseudotsuga menziesii* as the potential climax dominant are grouped into the *Pseudotsuga menziesii* series. The series is more than an artificial grouping of habitat types using the potential climax overstory dominant as the convenient thread of continuity. There is an ecologic basis for grouping habitat types into series. For example, *Pseudotsuga menziesii* occupies areas that are warmer and drier than areas where *Populus tremuloides* is climax. Continuing higher into the mountains, *Pinus contorta*, *Picea engelmannii*, and *Abies lasiocarpa* successively become the dominant species. In the absence of adequate climatic data for the White River National Forest, it is assumed that these self-perpetuating populations of dominant trees are related to the macroclimate, whereas the undergrowth vegetation is related more to microclimate and soils. Stands in a series have the same general appearance whether they are in the White River National Forest or in nearby forests of Colorado and Wyoming (Hoffman and Alexander 1980, Wirsing and Alexander 1975). Habitat types within a series are distinguished on the basis of undergrowth vegetation. For example, *Populus tremuloides* is widely distributed as a seral and climax species in western Colorado. Where it is climax, several undergrowth unions occur. The most luxuriant and widely distributed is the *Thalictrum fendleri* union. On some sites, a union formed by the single species *Heracleum sphondylium* forms a conspicuous layer. Where *Heracleum sphondylium* dominates the undergrowth, it forms another habitat type. Thus *Populus tremuloides/Thalictrum fendleri* and *Populus tremuloides/Heracleum sphondylium* are two distinct habitat types even though the *Thalictrum fendleri* union may be well-represented in both.

The White River National Forest has been disturbed by fire, logging, and grazing for many years. Because of these disturbances, not all of the land area currently supports climax vegetation. It is possible that much of the area of a habitat type will never attain climax status. Nevertheless, it is important to consider land units in terms of their potential status. The practical value of habitat type classifications is only beginning to be realized in areas of tree productivity, disease and insect susceptibility, potential for producing browse, soil moisture depth, and tree regeneration (Arno and Pfister 1977; Daubenmire 1961, 1973; Layser 1974; Pfister 1972). The habitat type concept offers a useful approach to managing forest resources.

HABITAT TYPES

Forest vegetation in the White River National Forest ranges from the xerophytic *Pinus edulis-Juniperus* sp.-dominated vegetation at the warmer, drier low elevations to the mesophytic *Abies lasiocarpa-Picea engelmannii*-dominated vegetation at the cooler, moister high elevations. Because of time limitations, and the fact that most of the lower elevation forests were outside the White River boundaries and had been heavily grazed, the *Pinus edulis-Juniperus* spp.- and *Quercus gambelii*-dominated vegetation was not extensively sampled. However, reconnaissance surveys were made on the areas dominated by these vegetation types.

Pseudotsuga menziesii Series

Pseudotsuga menziesii is not widespread or abundant on the White River National Forest. It grows only in small stands on steep slopes with shallow soils (fig. 2).

The *Pseudotsuga menziesii* series was sampled in only two plots and one habitat type that were on west- to northwest-facing slopes, at elevations of 8,400 to 8,850 feet (2,560 to 2,700 m). *Pseudotsuga menziesii* is climax in some areas and seral to *Abies lasiocarpa* and/or *Picea engelmannii* in others. Dominant *Pseudotsuga menziesii* in these stands range from about 80 to 120 years old at breast height. Basal areas on the study plots ranged from 131 to 135 square feet per acre (30 to 31 m²/ha). Tree sizes range from seedlings to the 12- to 16-inch (3- to 4-dm) d.b.h. class. Tree populations and undergrowth data for *Pseudotsuga menziesii* stands are shown in tables A-1 and A-2.

Pseudotsuga menziesii/Pachistima myrsinites

Description.—The *Pseudotsuga menziesii/Pachistima myrsinites* habitat type is recognized by the presence and reproductive success of *Pseudotsuga menziesii* (fig. 3) and by the abundance and dominance of *Pachistima myrsinites* in the undergrowth (fig. 4). Other important shrub species are *Berberis repens*, *Juniperus communis*, *Rosa* sp., and *Symphoricarpos oreophilus*. Herbaceous plants are not abundant in this habitat type. *Calamagrostis rubescens*, *Carex geyeri*, *Aquilegia caerulea*, *Arnica cordifolia*, *Galium boreale*, *Solidago* sp., and mosses and lichens are most common.

Hoffman and Alexander (1980) described this habitat type on the Routt National Forest in Colorado just north of the White River. No *Pseudotsuga*-dominated habitat types were reported in the Medicine Bow Mountains of southern Wyoming (Wirsing and Alexander 1975). In the Bighorn Mountains of north-central Wyoming, *Pseudotsuga* is widespread and dominates the *Pseudotsuga menziesii/Berberis repens* and *Pseudotsuga menziesii/Physocarpus monogynus* habitat types (Hoffman and Alexander 1976). *Pseudotsuga menziesii*-dominated habitat types are also common and widespread in north-



Figure 2.—Typical occurrence of *Pseudotsuga menziesii* between Eagle and Gypsum, in an open stand, on a steep slope, with very shallow soil.



Figure 3.—*Pseudotsuga menziesii*/*Pachistima myrsinites* habitat type. In this stand, on a steep west-facing slope, the trees are relatively dense. The meter stick used for scale in this and subsequent photos is painted in 1-dm increments.



Figure 4.—The *Pachistima myrsinites* undergrowth union. The dominant species here is *Pachistima* with lesser abundance of *Berberis repens*. Lichen-encrusted rock outcroppings, left side of photo, are relatively common in this habitat type.

ern Utah (Mauk and Henderson⁴), Montana (Pfister et al. 1977), and northern and central Idaho (Daubenmire and Daubenmire 1968, Steele et al. 1981).

Management Implications.—Little information is available on the management of this limited habitat type. Timber productivity is below the average for *Pseudotsuga*, because it grows in relatively dry situations. Regeneration is likely to be difficult to obtain if stands are clearcut. Group selection and shelterwood cuttings approximate the regeneration patterns observed in natural forests. Livestock forage production is low, and the potential for increasing it is not very great. Big game heavily browse the shrub species at times. Shrub species can be increased by maintaining low overstory basal areas. The potential for increasing natural runoff is not very great because of the limited area occupied by the habitat type.

Populus tremuloides Series

Populus tremuloides is widely distributed in western Colorado. In the White River National Forest, it grows at elevations ranging from about 8,000 feet (2,440 m) to about 10,500 feet (3,200 m). At the elevational extremes,

⁴Mauk, Donald L., and Jan A. Henderson. Forest habitat types of northern Utah, 303 p. Unpublished report, Department of Forestry and Recreation, Utah State University, Logan. On file at Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo. (FS-RM-MFRWU-1252).

Populus is often stunted. At the highest elevations, it grows on very rocky soils with sparse undergrowth (fig. 5), while at the lower edge of its range *Populus tremuloides* often grows in thickets with *Quercus gambelii*, *Amelanchier alnifolia*, and *Prunus virginiana* (fig. 6). Throughout most of its range on the White River, however, it forms large stands of sizable trees on all exposures, particularly at elevations ranging from 8,400 feet (2,530 m) to 10,000 feet (3,050 m) (table 1).

There has been considerable discussion regarding the role of *Populus tremuloides* as a climax and/or seral species in the Rockies; both assessments may be correct. In some areas, *Populus tremuloides* dominates sites where fires have destroyed coniferous forests. In time, conifers gradually replace *Populus tremuloides* (fig. 7). Succession to coniferous forest apparently is slowed significantly by changes in soil resulting from site occupancy by the deciduous *Populus*. In other areas, *Populus tremuloides* forests appear to be climax without evidence of conifer invasion. This is especially evident where large burns have eliminated the coniferous seed source from at least the central portion of the burned area, but it is also evident in some areas where a coniferous seed source is present. According to Mueggler (1976), complete conversion of *Populus* stands to coniferous climax forest may require more than 1,000 fire-free years. The origin of both seral and climax *Populus tremuloides*-dominated forests may be the same—destruction of coniferous forest by repeated fires.



Figure 5.—*Populus tremuloides* at 10,200 feet (3,100 m) is stunted and occurs on steep slopes with shallow soils.

Table 1.—Selected topographic and edaphic characteristics of the habitat types in the White River National Forest

Habitat type	Stands sampled	Elevation	Soil texture ¹	pH ¹	Organic matter
	<i>number</i>	<i>m</i>			<i>percent</i>
<i>Populus tremuloides</i> / <i>Symphoricarpos oreophilus</i>	8	2,652-2,858	Loam-clay loam	5.8-6.6	3.4-7.2
<i>Populus tremuloides</i> / <i>Heracleum sphondylium</i>	2	2,713-2,957	Clay loam	6.3-7.4	3.8-5.2
<i>Populus tremuloides</i> / <i>Carex geyeri</i>	4	2,972-3,033	Loam-sandy loam	6.0-6.2	2.0-3.1
<i>Populus tremuloides</i> / <i>Thalictrum fendleri</i>	12	2,560-3,048	Clay loam- sandy loam	5.8-6.7	3.2-6.6
<i>Populus tremuloides</i> / <i>Pteridium aquilinum</i>	1	2,682	Clay loam	6.0	5.2
<i>Pseudotsuga menziesii</i> / <i>Pachistima myrsinites</i>	2	2,560-2,697	Sandy loam	6.5	2.4
<i>Abies lasiocarpa</i> / <i>Carex geyeri</i>	5	2,713-2,960	Loam- clay loam	5.4-6.1	2.8-5.7
<i>Abies lasiocarpa</i> / <i>Vaccinium scoparium</i>	17	2,743-3,414	Silty loam- sandy loam	4.8-5.7	1.6-5.9

¹Upper 1 dm of soil.

Many *Populus tremuloides* forests are even-aged; the trees originate from sprouts after a disturbance (fig. 8). Baker (1925) suggested that in stands where older trees die naturally over a short time span, an even-aged replacement stand may develop. Other stands are uneven-aged, and sprouts apparently provide enough young trees to perpetuate the species indefinitely (fig. 9). Two-storied stands are also relatively common and can develop when surface fires burn quickly through mature stands, thereby stimulating sprouting (fig. 10).

On the White River National Forest, those plant communities dominated by *Populus tremuloides* which show no indication of being replaced by coniferous species are considered to be habitat types dominated by *Populus tremuloides*.

This series is represented by 26 plots, located on all aspects, at elevations of 8,400 to 10,000 feet (2,530 to 3,050 m). Five habitat types were recognized. Dominant *Populus tremuloides* in these stands range from about 100 to 180 years old at breast height. Basal areas on the study plots range from 96 to 300 square feet per acre (22

to 69 m²/ha). Tree sizes usually ranged from seedlings to the 16- to 20-inch (4- to 5-dm) d.b.h. class. Occasionally, there were scattered trees in the 20- to 24-inch (5- to 6-dm) d.b.h. class. Not all d.b.h. classes were represented on each plot. Tree population and undergrowth data for *Populus tremuloides* stands are shown in tables A-1, A-3, and A-4.

Populus tremuloides/Symphoricarpos oreophilus

Description.—The *Populus tremuloides*/Symphoricarpos oreophilus habitat type, represented by eight stands, is recognized by the consistent presence and reproductive success of *Populus tremuloides*, and the abundance and dominance of *Symphoricarpos oreophilus* in the undergrowth (fig. 11). This habitat type occupies the lower edge of the *Populus* zone on the Forest and is the driest *Populus tremuloides* habitat type. In the direction of drier habitats, *Populus tremuloides* is replaced by *Quercus gambelii*, *Pinus edulis*-*Juniperus* spp., or *Artemisia tridentata*-dominated vegetation. If replaced by *Quercus gambelii*, it forms the *Quercus gambelii*/Symphoricarpos oreophilus habitat type.

In addition to *Symphoricarpos oreophilus*, important shrubs are *Amelanchier alnifolia*, *Berberis repens*, *Prunus virginiana*, *Rosa* sp., *Pachistima myrsinites*, *Sambucus racemosa*, and *Sorbus scopulina*. The most important species in the rich mixture of graminoids and forbs are *Elymus glaucus*, *Galium boreale*, *Geranium richardsonii*, *Lathyrus leucanthus*, *Taraxacum* sp., *Thalictrum fendleri*, and *Vicia americana*.

Hoffman and Alexander (1980) identified this habitat type on the Routt National Forest in northwestern Colorado. A similar vegetation association occurs further south, on the Gunnison National Forest (Langenheim 1962, Morgan 1969). In the Medicine Bow National Forest and in the Bighorn Mountains, there are no understory unions dominated by *Symphoricarpos* (Wirsing and Alexander 1975, Hoffman and Alexander 1976). In western Wyoming, northern Utah, and central and southeastern Idaho, Mauk and Henderson,⁴ Mueggler and Campbell (1982), Steele et al. (1979), and Youngblood and Mueggler (1981) identified a *Populus tremuloides*/Symphoricarpos oreophilus-dominated vegetation with similar associated undergrowth. Mueggler and Campbell (1982) and Youngblood and Mueggler (1981) described this vegetation as a community type, but indicated that similar community types were probably stable and very likely valid habitat types.

Management Implications.—Timber productivity is low to moderate in this dry habitat type. Clearcutting and regenerating a new stand is usually the preferred way to handle these stands. Annual precipitation varies from 18 to 24 inches (46 to 61 cm) with about 9 to 12 inches (23 to 30 cm) of runoff. Potential for increasing streamflow under management is unknown. This habitat type is spring and fall big game range, and use may be heavy. In years of low snowfall, it may be used all winter. Browse production is moderate because of the presence of several tall shrubs that are highly palatable



Figure 6.—At mid-elevation on this slope, *Populus* occurs on deeper, colluvial soils. At its lower edge, it adjoins the lower-statured *Quercus gambelii*. On the far right is *Prunus virginiana* and *Amelanchier alnifolia*.



Figure 7.—Where conifers succeed *Populus tremuloides*, *Abies lasiocarpa* is more aggressive in becoming established.



Figure 8.—*Populus tremuloides* is present in four diameter classes in this stand, but the overstory is dominated by trees of 4-8 inches (1-2 dm) and 8-12 inches (2-3 dm) dbh sizes. In this *Populus tremuloides*/*Thalictrum fendleri* habitat type, basal area is 196 square feet per acre (45 m²/ha).

for big game. The habitat type is summer range for livestock. Under proper grazing management, herbage production may be as high as 500 to 800 pounds per acre (560 to 900 kg/ha), with high protein browse important. This habitat type has fairly good scenic quality, but generally with less favorable color contrast than with mixed *Populus*-conifer stands. Mature and open stands generally are more visually attractive, with the shrub understory providing both texture diversity and variety in seasonal color.

Populus tremuloides/*Thalictrum fendleri*

Description.—This habitat type, represented by 12 stands, is the most widespread of the *Populus*-dominated habitat types in the White River National Forest (fig. 12). It is recognized by the consistent reproductive success of *Populus tremuloides* and the high coverage of *Thalictrum fendleri* in the undergrowth. In nine of the stands sampled, *Populus tremuloides* was the only tree species. In the other stands, there was a scattering of *Abies lasiocarpa* seedlings, but no clear evidence that these stands were moving toward a climax dominated by conifers. Most of the stands in this habitat type appear to develop into uneven- or broad-aged stands that are self-perpetuating.

Symphoricarpos oreophilus is the most common shrub in the undergrowth. Important graminoids are *Bromus ciliatus*, *Carex geyeri*, and *Elymus glaucus*. Common forbs include *Achillea millefolium*, *Aquilegia caerulea*, *Aster engelmannii*, *Delphinium barbeyi*, *Erigeron* sp.,



Figure 9.—In this stand, *Populus tremuloides* is present in seven diameter classes, ranging from 0-4 inches (0-1 dm) to 24-28 inches (6-7 dm). The trees are more evenly distributed among the size classes larger than 0-4 inches (0-1 dm) which has the largest number of stems. This stand is also in the *Populus tremuloides/Thalictrum fendleri* habitat type. Basal area is 300 square feet per acre (69 m²/ha).



Figure 10.—The two-storied structure common in *Populus/Thalictrum* habitat types.



Figure 11.—The *Populus tremuloides*/*Symphoricarpos oreophilus* habitat type. Dominance of *Symphoricarpos* in the undergrowth is evident.



Figure 12.—The *Populus tremuloides*/*Thalicttrum fendleri* habitat type is widespread on the White River National Forest. In this stand, five diameter classes are present, ranging from 0-4 inches (0-1 dm) to 16-20 inches (4-5 dm). The undergrowth is a luxuriant mixture of mostly herbaceous species characteristic of the *Thalicttrum fendleri* union.

Fragaria sp., *Galium boreale*, *Geranium richardsonii*, *Heracleum sphondylium*, *Hydrophyllum capitatum*, *Lathyrus leucanthus*, *Ligusticum porteri*, *Osmorhiza* sp., *Thalictrum fendleri*, *Valeriana occidentalis*, and *Vicia americana* (fig. 13).

Hoffman and Alexander (1980) described this habitat type on the Routt National Forest, to the north of the White River. In the Crested Butte area of the Gunnison National Forest, Langenheim (1962) described *Populus*-dominated forests that appear to be similar to the *Populus tremuloides*/*Thalictrum fendleri* habitat type. Hess (1981) described a *Populus tremuloides*/*Thalictrum fendleri* habitat type on the Arapaho and Roosevelt National Forests, in north-central Colorado. In western Wyoming, and central and southeastern Idaho, Mueggler and Campbell (1982), and Youngblood and Mueggler (1981) described a *Populus tremuloides*/*Thalictrum fendleri* community type where the successional status of *Populus tremuloides* was in doubt. No plant associations with the *Thalictrum fendleri* union prevalent under *Populus* were found in the Medicine Bow National Forest or the Bighorn Mountains (Hoffman and Alexander 1976, Wirsing and Alexander 1975).

Management Implications.—The *Populus tremuloides*/*Thalictrum fendleri* habitat type is the most productive for timber in the *Populus* series. Site quality ranges from average to high. Clearcutting in patches or small blocks and regenerating new stands is the most effective way to handle these stands. This habitat type is the best summer range for big game and for sheep. Forage production under proper grazing management can be as high

as 3,000 pounds per acre (3,360 kg/ha). It also provides habitat for numerous nongame animals, but the management implications for them are unknown. This habitat type has the most visually appealing foreground of all *Populus*-dominated habitat types because of the usually wide spacing with large tree diameters and the abundance of wildflowers in the undergrowth. Soils are well developed, and erosion is usually not a problem except on deteriorated ranges. In some situations, potential for soil mass movement appears to be high, especially if the overstory is removed in large clearcut blocks. Annual precipitation is 25 to 40 inches (64 to 102 cm), with about one-half becoming runoff. Potential for increasing streamflow under management is unknown.

Populus tremuloides/*Carex geyeri*

Description.—The *Populus tremuloides*/*Carex geyeri* habitat type has a restricted distribution on the White River (fig. 14). The four stands sampled were on south-facing slopes where nutrient and organic matter content of the soils were lower than found under the two previously described *Populus* habitat types. *Populus tremuloides* was the only tree species in three stands and the dominant self-reproducing tree in the other stand. The undergrowth is dominated by *Carex geyeri* and has fewer species than stands with the *Thalictrum fendleri* union. Important shrubs include *Amelanchier alnifolia*, *Berberis repens*, *Pachistima myrsinites*, *Rosa* sp., and *Symphoricarpos oreophilus*. Herbaceous understory



Figure 13.—The density and richness of the *Thalictrum fendleri* union, conspicuous in the vicinity of the meter stick are *Aster engelmannii*, *Thalictrum fendleri*, *Osmorhiza occidentalis*, *Geranium richardsonii*, *Elymus glaucus*, *Lupinus argenteus*, *Delphinium barberi*, and *Ligusticum porteri*.



Figure 14.—The *Populus tremuloides*/*Carex geyeri* habitat type on a south-facing slope. *Populus* occurs in four diameter classes, ranging from 0.4 inches (0.1 dm) to 12.16 inches (3.4 dm). The understory is not as rich or dense as in the other *Populus tremuloides* habitat types.

species most conspicuous are *Bromus ciliatus*, *Arnica cordifolia*, *Carex geyeri*, *Elymus glaucus*, *Epilobium angustifolium*, *Achillea millefolium*, *Fragaria* sp., *Lathyrus leucanthus*, and *Smilacina racemosa* (fig. 15).

This habitat was not identified in the Routt National Forest north of the White River (Hoffman and Alexander 1980), but was found in the Arapaho and Roosevelt National Forests, in north-central Colorado (Hess 1981), and in Medicine Bow National Forest, in southern Wyoming (Wirsing and Alexander 1975). There were no vegetation associations dominated by *Carex geyeri* in the Bighorn Mountains (Hoffman and Alexander 1976). In northern Utah, Mauk and Henderson⁴ described a similar *Populus tremuloides*/*Carex geyeri*-dominated vegetation association as a community type.

Management Implications.—Timber productivity on this dry habitat is average to below average. Clearcutting and regenerating a new stand is usually the most effective way to perpetuate these stands. This habitat type is fair summer-fall range for big game and cattle. Forage production varies from 400 to 800 pounds per acre (450 to 900 kg/ha) depending upon range condition and management practices. Overgrazing may reduce *Carex* cover and expose soils that are difficult to revegetate. Annual precipitation varies from 20 to 30 inches (51 to 76 cm) with about 10 to 15 inches (25 to 38 cm) of runoff. Potential for increasing streamflow is unknown. Erosion, sedimentation, and mass movement potentials are low. This habitat type has fair scenic quality, with less favorable color contrast than with

mixed *Populus*-conifer stands. In open stands, the shrub understory provides both texture and variety in seasonal color. It also provides a pleasing ground color contrast in the fall when *Carex* remains green after other undergrowth vegetation has withered and died.

Populus tremuloides/*Pteridium aquilinum*

Description.—This habitat type was not widespread on the White River and is represented by only one stand in the study (fig. 16). *Pteridium aquilinum*, like *Populus tremuloides*, establishes rapidly after fire. Often it is replaced as succession advances other undergrowth unions, although it can perpetuate itself indefinitely. In this stand, *Pteridium aquilinum* appears quite stable. The stand sampled is on McClure Pass. *Populus tremuloides* was the only tree species in the stand. The undergrowth is dominated by *Pteridium aquilinum*. Other important understory species are *Elymus glaucus*, *Aster engelmannii*, *Fragaria* sp., *Lathyrus leucanthus*, *Thalictrum fendleri*, and *Vicia americana*.

It has been suggested that *Pteridium aquilinum* is an indicator of site deterioration resulting from overgrazing. The stand studied had not been grazed recently, and whether past grazing history significantly affected the composition of the undergrowth is not known.

The *Populus tremuloides*/*Pteridium aquilinum* habitat type was identified on the Routt National Forest, where it was confined to poorly drained areas north of



Figure 15.—Conspicuous species of the *Carex geyeri* undergrowth union include *Carex geyeri*, *Elymus glaucus*, *Castilleja sulphurea*, *Thalictrum fendleri*, *Lathyrus leucanthus*, *Arnica cordifolia*, and *Aster engelmannii*.



Figure 16.—*Populus tremuloides*/*Pteridium aquilinum* habitat type. In this stand, *Populus* is represented by four diameter classes ranging from 0.4 inches (0.1 dm) to 12.16 inches (3.4 dm). *Pteridium* provides nearly 80 % canopy coverage in the undergrowth. Under the *Pteridium* are members of the *Thalictrum fendleri* undergrowth union.

40°20'25"N latitude (Hoffman and Alexander 1980). *Pteridium aquilinum* was not reported as growing in *Populus*-dominated forests, on the Gunnison National Forest, to the south (Langenheim 1962, Morgan 1969), although it has been observed to be abundant in those forests. Northward in Wyoming, Utah, Montana, and Idaho, no *Populus*/*Pteridium* habitat types have been reported (Hoffman and Alexander 1976; Mueggler and Campbell 1982; Pfister et al. 1977; Steele et al. 1979, 1981; Wirsing and Alexander 1975; Youngblood and Mueggler 1981).

Management Implications.—This habitat type is restricted in area, and to poorly drained sites. The potential for timber and forage production and infiltration is less than in the *Populus tremuloides*/*Thalictrum fendleri* habitat type, and the potential for increased erosion, surface runoff, and soil mass movement is greater. The potential for soil damage from logging equipment is high when soils are wet. Species richness in the understory tends to be poor. This habitat type is most likely to occur in locations where cold air drainage and frost damage to *Populus* reproduction is likely in cleared openings.

Populus tremuloides*/*Heracleum sphondylium

Description.—The *Populus tremuloides*/*Heracleum sphondylium* habitat type, represented by only two stands on southeast slopes, has limited distribution on the White River National Forest (fig. 17). *Populus*

tremuloides is the only tree species present. Not all diameter classes are represented; neither stand contains trees in the 1-2 dm d.b.h. class. The understory is dominated by a tall layer (1-2 m) of *Heracleum sphondylium*. Under *Heracleum* are species of the *Thalictrum fendleri* union that includes *Bromus ciliatus*, *Elymus glaucus*, *Aquilegia coerulea*, *Geranium richardsonii*, *Senecio serra*, and *Thalictrum fendleri*.

Hoffman and Alexander (1980) described this habitat type on the Routt National Forest, in northwestern Colorado. On the Gunnison National Forest, south of the White River National Forest, Langenheim (1962) and Morgan (1969) reported *Heracleum* under more than half the mature *Populus* stands they examined. In western Wyoming, Youngblood and Mueggler (1981) described a *Heracleum lanatum* community type with similar undergrowth (*Heracleum lanatum* has been changed to *Heracleum sphondylium*). They suggested that this vegetation association occurred throughout Wyoming, but it was not found in the Bighorn Mountains or in the Medicine Bow National Forest (Hoffman and Alexander 1976, Wirsing and Alexander 1975). No *Populus*/*Heracleum*-dominated vegetation has been reported in Idaho or Montana (Mueggler and Campbell 1982; Pfister et al. 1977; Steele et al. 1979, 1981).

Management Implications.—Because this habitat type is quite similar in management implications to the *Populus tremuloides*/*Thalictrum fendleri* habitat type on the White River National Forest, the two can be treated in the same manner.



Figure 17.—The *Populus tremuloides*/*Heracleum sphondylium* habitat type. *Populus* is represented by trees ranging from 0-4 inches (0-1 dm) to 12-16 inches (3-4 dm) dbh. Undergrowth is dominated by *Heracleum sphondylium* which is flowering in this stand. Its coverage is 67%. Under the *Heracleum* are members of the *Thalictrum fendleri* undergrowth union.

Abies lasiocarpa Series

This series, represented by 22 plots, occupies the highest and coldest coniferous forest zone on the White River National Forest (table 1). These forests—dominated by *Abies lasiocarpa* and *Picea engelmannii*—are usually referred to as the subalpine forest zone on the White River National Forest. As throughout much of the Rocky Mountains, the subalpine forest zone is widespread and supports forests of considerable importance. On the White River National Forest, these forests are found on all aspects at elevations ranging from 8,900 feet (2,710 m) to 11,200 feet (3,410 m), a span of 2,300 feet (755 m). This zone generally has been considered to be about 2,000 feet (7,610 m) in elevational extent (Daubenmire 1943). It has been reported as low as 8,000 feet (2,625 m) to as high as 11,500 feet (3,500 m) in the central Rocky Mountains. In the White River National Forest, the lower elevational limits of *Abies lasiocarpa*-dominated forests and the upper elevational limits of the *Populus*-dominated forests overlap, although aspect and soils play some part in the forest distribution.

The habitat types described in this series are all named for *Abies lasiocarpa* as the climax dominant to be consistent with usage elsewhere (Daubenmire and Daubenmire 1968, Hoffman and Alexander 1976, 1980; Pfister et al. 1977; Steele et al. 1979, 1981; Wirsing and Alexander 1975). On the White River National Forest, *Picea engelmannii* is a co-climax dominant with little evidence that it will ever be completely replaced by *Abies lasiocarpa*. Young *Abies lasiocarpa* usually outnumber the young *Picea engelmannii*, because *Abies lasiocarpa* is more tolerant and reproduces by layering and from seeds, whereas *Picea engelmannii* reproduces almost entirely from seed. Because *Picea engelmannii* live longer, they are nearly always the largest trees in the stand. The only exception occurs in stands where *Picea engelmannii* has been severely attacked by the spruce beetle (*Dendroctonus rufipennis* Kirby). In most stands, *Pinus contorta* and/or *Populus tremuloides* are present as seral species. After disturbance, *Populus tremuloides* may establish initially to be succeeded by *Pinus contorta* which, in turn, is replaced by *Abies lasiocarpa* and *Picea engelmannii*. *Abies lasiocarpa* and *Picea engelmannii* can reestablish immediately with or without *Pinus contorta* and/or *Populus tremuloides*, depending on the topographic situation, the type of disturbance, and the availability of coniferous tree seed or the sprouting capacity of *Populus*.

Two habitat types were recognized in this series. Stands sampled ranged from 80 to more than 300 years old at breast height. Basal areas ranged from 28 to 409 square feet per acre (28 to 94 m²/ha). Tree sizes ranged from seedlings to the 24- to 28-inch (6- to 7-dm) d.b.h. classes, with an occasional tree in the more than 30-inch class (8+ dm). Tree population and undergrowth data are shown in tables A-1, A-5, and A-6.

Abies lasiocarpa/Vaccinium scoparium

Description.—The *Abies lasiocarpa*/Vaccinium scoparium habitat type is represented by 17 plots. In the stands sampled, nine were climax or near climax, and

eight were late seral succession. The habitat type is recognized by the almost constant presence and reproductive success of *Abies lasiocarpa* and by the abundance and understory dominance of *Vaccinium scoparium* in association with *Vaccinium myrtillus*. *Picea engelmannii* is present as a self-reproducing co-climax species (fig. 18).

The overstory of most of the stands is dominated by *Abies lasiocarpa* and *Picea engelmannii*. *Pinus contorta* is an important seral species, and still dominates some of the stands in late seral succession (fig. 19). However, the self-reproducing species in these stands are *Abies lasiocarpa* and *Picea engelmannii*, and no evidence was found to suggest a habitat type dominated by *Pinus contorta* in the White River National Forest. *Populus tremuloides* is only an occasional minor seral species. Ground cover varies from sparse to luxuriant. In general, undergrowth species richness declines from seral to climax successional stages and from young to old stands. In addition to *Vaccinium scoparium* and *Vaccinium myrtillus* which constitute more than 50% of the coverage, other important undergrowth species are *Arnica cordifolia*, *Carex geyeri*, *Pachistima myrsinites*, *Pedicularis racemosa*, and *Ramischia secunda* (fig. 20).

The *Abies lasiocarpa*/Vaccinium scoparium habitat type, or others very similar to it, occur throughout the Rocky Mountains (Hoffman and Alexander 1976, 1980; Mauk and Henderson⁴; Moir and Ludwig 1979; Pfister et al. 1977; Steele et al. 1979, 1981; Wirsing and Alexander 1975). However, there is considerable variability in the coverage of *Vaccinium scoparium* within this habitat type. Additionally, more broad-leaved herbaceous dicots occur in this habitat type on the western slope of the Rockies than on the eastern slope.

Management Implications.—Timber productivity varies considerably (Alexander 1967). Understory vegetation changes slowly after major disturbance, and competition is not severe between tree seedlings and understory vegetation, except where coverage of herbaceous dicots is high. There may be a manageable stand of advanced reproduction in much of this habitat type. While most silvicultural systems can be used (Alexander 1974), complete removal of the mature overstory by clearcutting in mixed stands where *Pinus contorta* makes up part of the overstory may result in an even-aged replacement stand of seral *Pinus contorta*. This also can happen with the final harvest cut under shelterwood methods, unless extreme care is taken in logging to protect advanced regeneration of *Abies lasiocarpa* and *Picea engelmannii*. In these mixed stands, using a standard or modified shelterwood system, the proportion of *Pinus contorta* retained in the first cut can be used to manipulate the amount of *Abies lasiocarpa* and *Picea engelmannii* in the stand. Clearcutting is likely to eliminate the chance for regeneration of *Picea engelmannii* on southerly exposures, for extremely long periods of time. Where protection from direct solar radiation and excessive soil moisture losses is necessary for survival of *Picea engelmannii* seedlings, standard or modified shelterwood are appropriate even-aged cutting methods. *Pinus contorta* may have to be planted to maintain forest cover, if clearings occur or are desired.



Figure 18.—The *Abies lasiocarpa/Vaccinium scoparium* habitat type on the Holy Cross District. This climax stand has a basal area of 410 square feet per acre (94 m²/ha) and is over 300 years old. *Abies* and *Picea engelmannii* are the only tree species represented. *Vaccinium scoparium* provides 60% coverage in the undergrowth.



Figure 19.—The *Abies lasiocarpa/Vaccinium scoparium* habitat type. This stand is still dominated by *Pinus contorta*, but it is seral to *Abies* and *Picea engelmannii*.



Figure 20.—*Vaccinium scoparium* undergrowth union may also have *Vaccinium myrtellus* and *Arnica cordifolia*. Note the rather sparse character of the undergrowth and the cones of *Pinus contorta*.

Uneven-aged management with group selection and/or individual tree selection cutting can be used in irregular-structured stands, or where the combination of openings and high forest is required to enhance recreational opportunities and amenity values. Group selection is likely to perpetuate the existing species mix, but may increase the proportion of *Pinus contorta*. Individual tree selection will favor *Abies lasiocarpa* over *Picea engelmannii*, and in mixed stands the proportion of both *Abies lasiocarpa* and *Picea engelmannii* will be increased, especially if the initial cutting removes a large proportion of *Pinus contorta*.

The *Abies lasiocarpa/Vaccinium scoparium* habitat type is not heavily used by livestock, but is big game summer range. It occupies areas with the greatest potential for water yield (up to 20 inches (50 cm) of natural runoff annually) in the White River National Forest. Small patch (3- to 5-acre (1.24- to 2.02-ha)) or strip (400-foot (122-m)) clearcuts result in greater forage production for big game and larger increases in water available for streamflow than either shelterwood, group selection, or individual-tree selection cutting (Alexander 1977, Alexander and Edminster 1980, Leaf 1975, Leaf and Alexander 1975, Regelin and Wallmo 1978, Wallmo et al. 1972). Because forage production begins to decline in about 15 to 20 years, and water production in 20 to 30 years, new openings must be cut periodically to maintain these increases.

Abies lasiocarpa/Carex geyeri

Description.—This habitat type, represented by five stands generally on northwest to west aspects, is distinguished by the dominance of *Carex geyeri* in the undergrowth, and the scarcity of *Vaccinium scoparium*, and the near absence of *Vaccinium myrtillus* (fig. 21). The overstory dominants are *Abies lasiocarpa* and *Picea engelmannii*. *Pinus contorta* and *Populus tremuloides* are seral species, with *Populus tremuloides* a much more important seral species than in the *Abies lasiocarpa/Vaccinium scoparium* habitat type; however, neither seral species shows any significant evidence of self-perpetuation. Important undergrowth species in addition to *Carex geyeri* are *Arnica cordifolia*, *Aster engelmannii*, *Geranium richardsonii*, *Lathyrus leucanthus*, *Ligusticum porteri*, *Osmorhiza* sp., and *Thalictrum fendleri*.

This habitat type generally occurs at lower elevations and in drier situations than the *Abies lasiocarpa/Vaccinium scoparium* habitat type. At higher elevations, the *Abies lasiocarpa/Carex geyeri* habitat type is usually found on south and west aspects; whereas the *Abies lasiocarpa/Vaccinium scoparium* habitat type occurs on north and east aspects at upper elevations.

This habitat type was described in the Routt National Forest, in northwestern Colorado, by Hoffman and Alexander (1980). An *Abies lasiocarpa/Carex geyeri* habitat

type also has been reported in the Arapaho and Roosevelt National Forests in north-central Colorado (Hess 1981); the Medicine Bow Mountains in southern Wyoming (Wirsing and Alexander 1975); and in western Wyoming in Yellowstone National Park and the Teton National Forest (Steele et al. 1979). In Montana, an *Abies lasiocarpa*/*Carex geyeri* habitat type is a minor habitat type, occurring on cold, dry sites (Pfister et al. 1977), but is common in central Idaho on granitic soils (Steele et al. 1981). The habitat type does not occur in the Bighorn or Wind River Mountains of Wyoming (Hoffman and Alexander 1976, Steele et al. 1979) or in eastern Washington or northern Idaho (Daubenmire and Daubenmire 1968).

Management Implications.—Understory vegetation in this habitat type recovers slowly from major disturbance. Tree reproduction in this dry, cold habitat type is more difficult to obtain, and competition between tree seedlings and understory vegetation is more severe than in the *Abies lasiocarpa*/*Vaccinium scoparium* habitat type. In fact, if tree seedlings are slow to establish after clearcutting, the site may become fully occupied by *Carex geyeri*. *Pinus contorta* is the tree species most likely to compete successfully with *Carex geyeri* following major disturbance. Timber productivity is average to below average. Cutting methods applicable are similar to those suggested for the *Abies lasiocarpa*/*Vaccinium scoparium* habitat type; however, seral stands of *Pinus contorta* are more likely to be susceptible to mountain pine beetle than *Abies lasiocarpa*/*Carex geyeri* habitat types. Where there is an appreciable amount of either

Pinus contorta or *Populus tremuloides* in the stands, clearcutting or simulated shelterwood is likely to increase their representation in the new stand. This habitat type provides forage for livestock and big game. Heavy grazing may reduce the *Carex geyeri* cover and expose soils difficult to revegetate. Natural runoff (15 inches (38 cm)) is less than in the *Abies lasiocarpa*/*Vaccinium scoparium* habitat type, but can be increased significantly using the same cutting methods suggested for *Abies lasiocarpa*/*Vaccinium scoparium* habitat type.

OTHER VEGETATION

There are other forest habitat types and associated vegetation on the White River National Forest. Those described below were not sampled quantitatively because of time limitations, but a number of stands in each were visited and quantitatively evaluated with notes on both overstory and undergrowth vegetation.

Quercus gambelii/*Symphoricarpos oreophilus*

Description.—The *Quercus gambelii*/*Symphoricarpos oreophilus* habitat type usually occupies a zone between the *Pinus edulis*-dominated vegetation below and the *Populus tremuloides*-dominated vegetation above. The *Quercus* zone may also contact the *Artemisia tridentata*-dominated vegetation at either its upper or lower margins (fig. 22); and in some places, it may occur above



Figure 21.—*Abies lasiocarpa*/*Carex geyeri* habitat type. This climax forest has a basal area of 322 square feet per acre (74 m²/ha). The generally untidy appearance is typical of climax forests of the *Abies lasiocarpa* series.



Figure 22.—The *Quercus gambelii*/*Symphoricarpos oreophilus* habitat type. The dense growth of *Quercus* is characteristic and produces thickets that are in some cases difficult to penetrate. This stand abuts the *Artemisia tridentata*-dominated shrub-steppe.

the *Populus*-dominated vegetation. Regardless of where it occurs relative to other vegetation, the *Quercus gambelii*/*Symphoricarpos oreophilus* habitat type is wetter than *Pinus edulis*- and *Artemisia*-dominated vegetation and drier than *Populus*-dominated vegetation.

The understory of this habitat type characteristically has both woody and herbaceous species, but is dominated by *Symphoricarpos oreophilus*. *Amelanchier alnifolia* and *Prunus virginiana* are important shrubs. *Wyethia amplexicaulis*, *Balsamorhiza sagittata*, and *Artemisia tridentata* are conspicuous in open areas, with *Wyethia* more important where grazing is heavy. This habitat type is well-developed in the southwestern part of the White River National Forest and occurs on the Routt National Forest (Hoffman and Alexander 1980). Southwest from the White River National Forest into the Gunnison and Grand Mesa National Forests, *Quercus*-dominated vegetation becomes more important. Wirsing and Alexander (1975) did not identify a *Quercus gambelii* habitat type on the Medicine Bow National Forest, in southern Wyoming, but did recognize a dry *Quercus gambelii* community in the foothills and lower canyons.

Management Implications.—Little is known about this dry habitat type. It has little value for timber other than for fuelwood or water production. *Quercus gambelii* regenerates vigorously from sprouts after clear-cutting or fire. Value for livestock varies with the amount of graminoids in the understory. It provides spring and fall habitat for big game and food and cover for nongame animals.

Pinus edulis/*Juniperus* spp.

Description.—*Pinus edulis*, along with *Juniperus osteosperma*, *Juniperus scopulorum*, and *Juniperus monosperma*, dominate this habitat type at low elevations (6,100 feet (1,860 m) to 6,600 feet (2,010 m)) on the White River National Forest (fig. 23). Within this zone, *Juniperus* species are usually more prevalent on lower slopes, while *Pinus edulis* is more numerous on upper slopes. All stands examined in this habitat type grew on shallow, rocky soils. Dominance is often shared by *Pinus edulis* and the three *Juniperus* species. Both *Pinus* and *Juniperus* are represented by several size classes up to and including 12 to 16 inches (3 to 4 dm) d.b.h., with a few individuals as large as 16 to 20 inches (4 to 5 dm) d.b.h. Basal areas in four stands ranged from 74 to 235 square feet per acre (17 to 54 m²/ha).

The undergrowth in these stands is both woody and herbaceous, and in some areas is extremely sparse because of heavy grazing. The more conspicuous shrubs are *Artemisia tridentata*, *Atriplex canescens*, *Cercocarpus montanus*, *Chrysothamnus nauseosus*, *Philadelphus microphyllus*, and *Rhus aromatica*. Important graminoids are *Agropyron smithii*, *Bromus tectorum*, *Bouteloua gracilis*, *Festuca idahoensis*, and *Stipa comata*. The most common forbs are *Astragalus* sp., *Cryptantha* sp., *Eriogonum umbellatum*, *Haplopappus* sp., *Oryzopsis* sp., *Senecio integerrimus*, and *Sphaeralcea coccinea*. The *Pinus edulis*/*Juniperus* spp., habitat type is a minor component of the vegetation in the White River National Forest. It is best represented along the lower western

edge of the White River Plateau, but most stands are below the forest boundary. No *Pinus edulis*/*Juniperus* spp.-dominated vegetation grows within the boundaries of the Routt National Forest (Hoffman and Alexander 1980), but west and south of the White River National Forest, it becomes a conspicuous feature of the landscape.

Management Implications.—Little is known about this dry habitat type. It has little value for water or timber production, although both *Pinus* and *Juniperus* are cut for fuelwood and fenceposts. Historical records indicate that both *Pinus* and *Juniperus* have increased with protection from fire. Value for livestock varies with the amount of graminoids in the undergrowth. It is important winter range for deer and provides both food and cover for nongame species.

Picea pungens/Poa spp.

Description.—The *Picea pungens*/Poa spp. habitat type occurs along streams over much of the southern half of the White River National Forest. It is generally confined to narrow, streamside terraces and extends upslope for short distances in narrow canyons. Occasionally, a small grove of *Picea pungens* is found at higher elevations. Most stands have been disturbed; and in many places only a few scattered *Picea pungens* are left, surrounded by a rank growth of heliophytic shrubs

and herbaceous vegetation. Both *Pseudotsuga menziesii* and *Populus tremuloides* grow in some stands with *Picea pungens*. In narrow, steep-walled canyons, *Abies lasiocarpa*-*Picea engelmannii*-dominated vegetation may mingle with *Picea pungens*-dominated vegetation (fig. 24).

Poa spp. are common in the undergrowth of most *Picea pungens* stands. Some of the other conspicuous undergrowth species include: *Amelanchier alnifolia*, *Berberis repens*, *Pachistima myrsinites*, *Rosa* sp., *Rubus parviflorus*, *Symphoricarpos oreophilus*, *Bromus ciliatus*, *Carex* spp., *Achillea millefolium*, *Fragaria* sp., *Galium boreale*, *Geranium richardsonii*, *Lathyrus leucanthus*, *Osmorhiza* sp., *Senecio wootonii*, and *Vicia americana*. Hess (1981) identified a *Picea pungens*/*Arnica cordifolia* habitat type in the Arapaho and Roosevelt National Forests, in north-central Colorado, but no other *Picea pungens*-dominated habitat types have been recognized in the central Rocky Mountains (Hoffman and Alexander 1976, 1980; Wirsing and Alexander 1975). A number of *Picea pungens*-dominated habitat types occur in the Southwest and in Utah (Mauk and Henderson,⁴ Moir and Ludwig 1979).

Management implications.—This habitat type is primarily valuable for scenic beauty and for protection of streambanks. It is moderately productive for timber and often critically important for wildlife associated with riparian vegetation.



Figure 23.—The *Pinus edulis*/*Juniperus* spp. habitat type occurs on xeric habitats at low elevations. The undergrowth is relatively sparse and the soils are very shallow.



Figure 24.—*Picea pungens* occurs along streams and abuts *Abies lasiocarpa* and *Picea engelmannii* upslope. Fringing *Picea pungens* on the streamside is a band of deciduous shrubs. Stand is east of Basalt along the Frying Pan River.

Pinus ponderosa

Description.—As in the Routt National Forest (Hoffman and Alexander 1980), *Pinus ponderosa* is a very minor species in the White River National Forest. An occasional old specimen grows in stands of the *Pseudotsuga menziesii*/*Pachistima myrsinites* habitat type (fig. 25). Others grow on disturbed sites on steep rocky slopes, but there are no contiguous stands of *Pinus ponderosa* left on the White River National Forest. The few original stands were destroyed by logging and fire before 1900 (Sudworth 1898).

KEY TO THE FOREST HABITAT TYPES OF THE WHITE RIVER NATIONAL FOREST

1. Deciduous trees dominant and reproducing; conifers may be present but are ordinarily rare and are not reproducing sufficiently to become dominant

2. *Quercus gambelii* dominant; other tree species absent or not dominant . . . *QUERCUS GAMBELII*/*SYMPHORICARPOS OREOPHILUS* H.T.
2. *Quercus gambelii* absent or not dominant; *Populus tremuloides* dominant
3. Undergrowth dominated by *Symphoricarpos oreophilus* *POPULUS TREMULOIDES*/*SYMPHORICARPOS OREOPHILUS* H.T.
3. Undergrowth dominated by rich mixture of herbaceous plants; *Symphoricarpos oreophilus* may be present but is not dominant
4. Undergrowth dominated by *Pteridium aquilinum* *POPULUS TREMULOIDES*/*PTERIDIUM AQUILINUM* H.T.
4. *Pteridium aquilinum* may be present in the undergrowth but is not dominant
5. Undergrowth dominated by *Heracleum sphondylium* *POPULUS TREMULOIDES*/*HERACLEUM SPHONDYLIIUM* H.T.
5. *Heracleum sphondylium* may be present in the undergrowth but is not dominant
6. Undergrowth dominated by *Carex geyeri*; *Arnica cordifolia* may also be important. Undergrowth may be a rich mixture of species, but *Thalictrum fendleri*, *Aster engelmannii*, *Geranium richardsonii*, and *Ligusticum porteri* are usually absent or not abundant *POPULUS TREMULOIDES*/*CAREX GEYERI* H.T.
6. *Carex geyeri* present in the undergrowth ordinarily; but the rich undergrowth is dominated by *Thalictrum fendleri* with considerable coverage provided by *Aster engelmannii*, *Geranium richardsonii*, and *Ligusticum porteri* *POPULUS TREMULOIDES*/*THALICTRUM FENDLERI* H.T.

1. Deciduous trees may be present but are neither dominant nor reproducing sufficiently to maintain their populations; conifers or junipers dominant and reproducing satisfactorily
7. *Pinus edulis* and/or *Juniperus scopulorum*, *Juniperus osteosperma*, or *Juniperus monosperma* dominant and reproducing. Other gymnosperms absent . . . *PINUS EDULIS*/*JUNIPERUS* SPP. H.T.
7. *Pinus edulis*, *Juniperus scopulorum*, *Juniperus osteosperma*, and *Juniperus monosperma* absent or rare
8. *Pseudotsuga menziesii* dominant and reproducing; other conifers may be present but are occasional or rare and are not reproducing in sufficient numbers to maintain a population . . . *PSEUDOTSUGA MENZIESII*/*PACHISTIMA MYRSINITES* H.T.

8. *Pseudotsuga menziesii* absent or rare or occasional and not reproducing
9. *Picea pungens* dominant and reproducing. Other tree species may be present but are occasional or rare and are not reproducing in sufficient numbers to maintain a population . . *PICEA PUNGENS*/POA SPP. H.T.
9. *Picea pungens* absent or very rare and not reproducing. *Abies lasiocarpa* and/or *Picea engelmannii* dominant and reproducing. *Pinus contorta* may be an important member of the overstory
10. Undergrowth dominated by *Vaccinium scoparium* . *ABIES LASIOCARPA*/ *VACCINIUM SCOPARIUM* H.T.
10. *Vaccinium scoparium* may be present but is not dominant. The undergrowth dominated by *Carex geyeri* . . . *ABIES LASIOCARPA*/ *CAREX GEYERI* H.T.

The distribution and successional status of tree species in relation to habitat type are shown in figure 26.

DISCUSSION

Validity of Habitat Type Classification

The practical value of the habitat type classifications has only begun to be realized in areas of vegetation map-

ping, relation to tree growth, susceptibility to diseases, production of browse species for game animals, and in providing a framework within which to relate additional basic or applied biological studies (Daubenmire 1961, 1973, 1976).

The classification system, while using vegetation as the indicator of site potentials, combines available related information on soil and climate. While initially using vegetation as the criterion of delimiting habitat types, this approach also takes a holistic view of units of land area. The older the stands observed, the more closely they approximate the potential (climax or near climax) of the landscape units studied (Daubenmire 1976).

This classification system utilizes both overstory and undergrowth vegetation in recognizing habitat types. In this study, the two major vegetation zones are dominated by *Populus tremuloides*, and *Abies lasiocarpa* and *Picea engelmannii*. It is apparent that the *Populus* zone on the White River National Forest and elsewhere in Colorado is warmer and drier than the *Abies* zone. Edaphic factors are also more alike within than between zones.

The classification of habitat types recognizes climax tree species in an area; these are given primary consideration, and important seral species are noted. Undergrowth vegetation is then used to indicate habitat types within the zone where a given tree species is climax. Within the *Populus* zone of the White River National Forest, five habitat types were recognized based on relatively few species. The *Populus tremuloides*/



Figure 25.—On exposed xeric sites, an occasional *Pinus ponderosa* occurs, often in association with *Pseudotsuga menziesii*. This stand is on a south-facing slope above the Frying Pan River east of Basalt.

Species \ Habitat Type	<i>Pinus edulis</i>	<i>Juniperus scopulorum</i> , <i>J. osteosperma</i> , <i>J. monosperma</i>	<i>Quercus gambelii</i>	<i>Pinus ponderosa</i>	<i>Pseudotsuga menziesii</i>	<i>Populus tremuloides</i>	<i>Pinus contorta</i>	<i>Abies lasiocarpa</i>	<i>Picea engelmannii</i>	<i>Picea pungens</i>
<i>Pinus edulis</i> / <i>Juniperus</i> spp.	C	C								
<i>Quercus gambelii</i> / <i>Symphoricarpos oreophilus</i>		o	C	o	o					
<i>Pseudotsuga menziesii</i> / <i>Pachistima myrsinites</i>		o		o	C	o		o	o	
<i>Populus tremuloides</i> / <i>Symphoricarpos oreophilus</i>						C		o		
<i>Populus tremuloides</i> / <i>Pteridium aquilinum</i>						C		o		
<i>Populus tremuloides</i> / <i>Heracleum sphondylium</i>						C		o		
<i>Populus tremuloides</i> / <i>Thalictrum fendleri</i>						C		o	o	
<i>Populus tremuloides</i> / <i>Carex geyeri</i>						C		o		
<i>Abies lasiocarpa</i> / <i>Vaccinium scoparium</i>					o	s	S	C	C	
<i>Abies lasiocarpa</i> / <i>Carex geyeri</i>						S	s	C	C	
<i>Picea pungens</i> / <i>Poa</i> spp.					o	o				C

C = Climax; S = Major Seral; s = minor seral; o = occasional.

Figure 26.—The ecologic roles of tree species in habitat types of the White River National Forest.

Thalictrum fendleri, and *Populus tremuloides*/*Symphoricarpos oreophilus* habitat types are considered to be climatic climaxes. The *Populus tremuloides*/*Thalictrum fendleri* habitat type occupies soils apparently developed through normal processes throughout most of the zone. The *Populus tremuloides*/*Carex geyeri* habitat type is considered to be a topoedaphic climax and generally occupies drier south-facing sites with shallow soils at the upper edges of the zone. The *Populus tremuloides*/*Symphoricarpos oreophilus* habitat type normally occupies soils developed in place at lower and drier edges of the zone. Throughout most of the *Populus*-dominated zone, there are restricted areas where combinations of edaphic and topographic characteristics allow *Heracleum sphondylium*- and *Pteridium aquilinum*-dominated undergrowth to establish under *Populus*. Although *Populus tremuloides*/*Thalictrum fendleri* is the climatic climax throughout much of the *Populus* zone, undergrowth vegetation is expressed rather independently of the *Populus tremuloides* overstory.

In the *Abies lasiocarpa* zone, the two habitat types, *Abies lasiocarpa*/*Vaccinium scoparium* and *Abies lasiocarpa*/*Carex geyeri*, are distinguished by differences in relatively few undergrowth species. However, the two habitat types also show some topographic and elevational differences. Additionally, *Populus tremuloides* is an important seral species in the *Abies lasiocarpa*/*Carex geyeri* habitat type but only a minor seral species in the *Abies lasiocarpa*/*Vaccinium scoparium* habitat type. Conversely, *Pinus contorta* is an important seral species in the *Abies lasiocarpa*/*Vaccinium scoparium* habitat type but only a minor component of the *Abies lasiocarpa*/*Carex geyeri* habitat type.

Distribution and Dynamics of Forest Tree Species

An example of the typical vegetation zonation on the White River National Forest—above Elk Creek to Cline-tops northwest of Newcastle—is shown in figure 27.

Pseudotsuga menziesii, which may grow above or below the *Populus tremuloides* zone, is not shown, because *Pseudotsuga menziesii* is not widely distributed on the White River National Forest. Neither is the *Artemisia tridentata* zone because this shrub-dominated steppe occurs most often below the forest boundary.

Populus tremuloides is the most widely distributed tree on the White River National Forest. It reaches maximum abundance at elevations from about 8,530 feet (2600 m) to 10,000 feet (3050 m). At its upper elevational limits, *Populus tremuloides* extends into the *Abies lasiocarpa* zone. The role of *Populus tremuloides* as a seral and/or climax species has been discussed at length by Baker (1925), Dixon (1935), Fetherolf (1917), Gardner (1905), Mueggler and Campbell (1982), Sampson (1925), and Youngblood and Mueggler (1981). Most investigators have agreed that *Populus tremuloides* is an aggressive species on areas that have been burned, logged, or otherwise disturbed; it reproduces primarily by root suckers. There is less agreement on the stability of *Populus tremuloides* once it is established. Data and observations from the present study suggest that both seral and climax stands of *Populus tremuloides* occur in the White River National Forest, as was observed in an earlier study on the Routt National Forest (Hoffman and Alexander 1980). Seral *Populus* stands are quite obvious where *Abies lasiocarpa* and *Picea engelmannii* are the climax species. In *Abies*-dominated habitat types, either *Populus tremuloides* or *Pinus contorta* may become established first after disturbance, or they may establish simultaneously. The availability of *Pinus* seed or *Populus* root sprouts determines which species initially becomes established.

Climax stands of *Populus tremuloides* show no clear evidence of successful conifer invasion. *Picea engelmannii* and *Pinus contorta* are rare in these stands, but an occasional *Abies lasiocarpa* may occur. The presence of a limited number of coniferous seedlings in the undergrowth is insufficient evidence of a successional trend, however. In addition, *Populus* usually has a stable population structure. The understory vegetation of the *Populus*-dominated habitat types is distinct, although

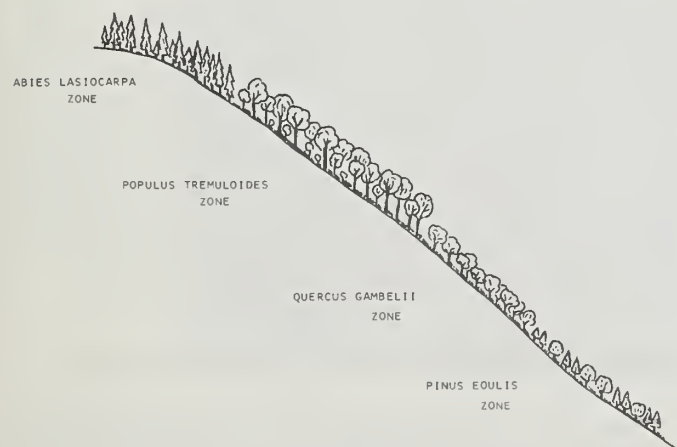


Figure 27.—Vegetation zonation above Elk Creek to Clinetops northwest of Newcastle.

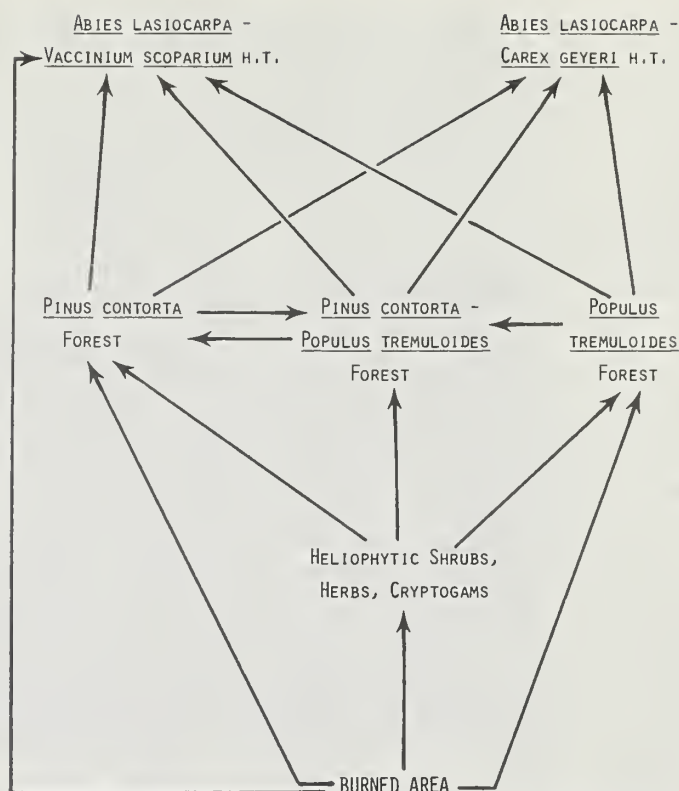


Figure 28.—Pathways of secondary succession following fire in *Abies lasiocarpa*-*Picea engelmannii*-dominated vegetation in the White River National Forest.

common species occur between *Populus tremuloides*-dominated habitat types and other habitat types in the Forest. Some soils differences exist between *Populus*-dominated and *Abies*-dominated habitat types. The oldest stand of climax *Populus*-dominated habitat types on the White River National Forest was about 180 years old, and it is unknown if these trees are first generation after fire. If succession toward *Abies* and *Picea* forests is not evident in these stands, they should be viewed and managed as climax forests.

Abies lasiocarpa and *Picea engelmannii* dominate vegetation in the subalpine zone, which occurs from about 9,000 feet (2740 m) elevation to timberline. Neither species is important in other elevational zones. In the *Abies lasiocarpa*/*Vaccinium scoparium* habitat type, *Populus tremuloides* is not an important seral species compared to *Pinus contorta*. In the *Abies lasiocarpa*/*Carex geeyeri* habitat type, the reverse seems to be true. On the basis of observations made during this study, figure 28 is suggested as a working model of succession following fire, in *Abies*-dominated forests, on the White River National Forest. From the population structures of seral communities, it appears that succession ordinarily follows one of the pathways shown in figure 28. This is somewhat different than secondary succession observed in the Routt National Forest (Hoffman and Alexander 1980). Following fire, in subalpine forests, on the White River National Forest, early successional communities are often a mixture of heliophytic shrubs, herbs, and cryptogams. In some localities, this stage of succession is prolonged, especially where the combina-

tion of a lack of seed source and/or root suckers and severe climate slow succession after large fires (fig. 29). Where abundant seeds and/or root suckers are available, fire can be followed promptly by *Populus tremuloides* and/or *Pinus contorta* regeneration. In some situations in the *Abies lasiocarpa/Vaccinium scoparium* habitat type, *Abies lasiocarpa*- and *Picea engelmannii*-dominated forests develop after fire without the seral stages of *Pinus contorta*, or *Populus tremuloides* (fig. 30). This successional trend has not been observed in *Abies lasiocarpa/Carex geyeri* habitat type, however. There also can be some shifting of dominance within the seral communities. On the White River National Forest, *Pinus contorta*-dominated forests may become *Pinus contorta/Populus tremuloides*-dominated forests, if *Populus* is present and *Pinus* does not fully occupy the site or *Pinus* stands begin to break-up. The reverse of this also happens with *Pinus*-*Populus*-dominated forests becoming *Pinus*-dominated forests. *Populus tremuloides*-dominated forests may add *Pinus contorta* before succession of *Abies*-dominated forests is completed, but *Pinus*-*Populus*-dominated forests usually do not lose the *Pinus* component before succeeding to *Abies*-dominated forests. In the case of succession on *Abies lasiocarpa/Carex geyeri* habitat types, most stands examined show evidence of going directly from *Populus*-dominated vegetation to *Abies*-dominated vegetation without *Pinus contorta*.

Pinus contorta forms no climax forests on the White River National Forest, although it is an important seral species over much of the *Abies lasiocarpa* zone. This observation is in contrast to its position on the Routt National Forest, where it is a climax species over a limited segment of its range and is an important seral species over much of the subalpine zone. It occurs also in numerous stands of *Populus tremuloides* (Hoffman and Alexander 1980). In the Crested Butte area to the south, Langenheim (1962) found seral *Pinus contorta* stands on burned areas, principally on north slopes with granitic or coarse textured soils, and at elevations of 9,500 feet (2,900 m) to 10,500 feet (3,200 m). In the Medicine Bow Mountains, *Pinus contorta* is an important seral species in *Abies lasiocarpa/Vaccinium scoparium* and *Abies lasiocarpa/Carex geyeri* habitat types. It also grows occasionally in stands dominated by *Populus tremuloides* (Wirsing and Alexander 1975).

The absence of a well-defined *Pseudotsuga* zone over much of the White River National Forest probably results from drought at low elevations and low temperatures at higher elevations. Moreover, *Pseudotsuga menziesii* shows little tendency to establish in areas now occupied by *Populus tremuloides*. Nor are there relicts of *Pseudotsuga menziesii* in *Populus tremuloides* stands to suggest it was formerly present.

Pinus ponderosa is rare, although an occasional old specimen grows in stands of *Pseudotsuga menziesii*- or *Quercus gambelii*-dominated vegetation. As indicated previously *Pinus ponderosa* has been nearly depleted by early logging and subsequent burning.

Quercus gambelii usually occupies xeric habitats in a zone below the *Populus tremuloides* zone. It often grows above or below the *Pinus edulis/Juniperus* spp. zone, and

depending on slope and exposure it may also grow above *Populus tremuloides* (figure 31). *Quercus gambelii* and *Populus tremuloides* develop fewer mixed stands on the White River National Forest than grow on the Routt National Forest. Moisture may be a more limiting factor in the White River National Forest; where *Quercus* is abundant in the southwestern part of the Forest, there is little *Populus*.

Pinus edulis and *Juniperus* spp. have a limited distribution in the White River National Forest. Most stands dominated by these species grow below the lower boundaries of the Forest. It does not appear from limited observation that either *Pinus edulis* or *Juniperus* spp. move upslope into *Quercus gambelii*- or *Populus tremuloides*-dominated vegetation after sites have been disturbed. The only exception to this is an occasional specimen of *Juniperus scopulorum* growing in stands of *Pseudotsuga*- or *Quercus*-dominated vegetation.

Species Richness

The median numbers of undergrowth species in stands in each habitat type are given in table 2. Species richness is generally highest in the *Populus*-dominated habitat types and lowest in the *Abies*- and *Pseudotsuga*-dominated habitat types. In those habitat types that grow on both the White River and Routt National Forests, the median numbers of undergrowth species are quite similar, except for the *Pseudotsuga menziesii/Pachistima myrsinites* habitat type where the median numbers of undergrowth species was 21 on the White River National Forest and only 8 on the Routt National Forest. Tree species richness was highest on the *Abies*- and *Pseudotsuga*-dominated habitat types and lowest on the *Pinus edulis/Juniperus* spp.- and *Populus*-dominated habitat types. With the exception of the *Populus tremuloides/Symphoricarpos oreophilus* habitat type, *Populus*-dominated habitat types generally had fewer shrubs than *Abies*- and *Pseudotsuga*-dominated habitat types.

Species richness also has been reported for habitat types elsewhere in the Rockies. In the Wind River Mountains, it increased with increasing elevation (Reed 1969). In northern Idaho and eastern Washington, undergrowth species richness among climatic climaxes was greatest in mid-elevational habitat types dominated by *Pseudotsuga menziesii* and *Abies grandis*, and tree species richness was greatest in the *Abies lasiocarpa*-dominated habitat types (Daubenmire and Daubenmire 1968). In the Bighorn Mountains, greatest undergrowth species richness was in low and high elevation habitat types dominated by *Pinus ponderosa* and *Abies lasiocarpa*, respectively (Hoffman and Alexander 1976).

Further Studies in Relation to the Habitat Types

The present study was to provide a basic classification of the forest habitat types in the White River National Forest. There are numerous areas of research which logically follow this study.



Figure 29.—Slow regeneration of *Abies lasiocarpa* and *Picea engelmannii* following an apparently extensive fire and salvage logging on White River Plateau. The dense herbaceous vegetation may compete effectively with germination and establishment of conifers.



Figure 30.—On this roadcut, *Picea engelmannii* is becoming established on bad mineral soil.

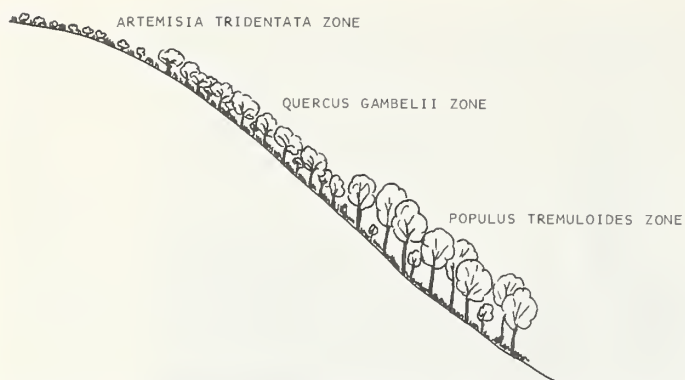


Figure 31.—Vegetation zonation above Elk Creek north of Newcastle.

Table 2. Species of undergrowth vegetation in habitat types of the White River National Forest

Habitat type	Median number ¹ of undergrowth species	Number of stands studied
<i>Pseudotsuga menziesii</i> / <i>Pachistima myrsinites</i>	21	2
<i>Populus tremuloides</i> / <i>Symphoricarpos oreophilus</i>	27	8
<i>Populus tremuloides</i> / <i>Thalictrum fendleri</i>	26	12
<i>Populus tremuloides</i> / <i>Pteridium aquilinum</i>	35	1
<i>Populus tremuloides</i> / <i>Heracleum sphondylium</i>	20	2
<i>Populus tremuloides</i> / <i>Carex geyeri</i>	21	4
<i>Abies lasiocarpa</i> / <i>Vaccinium scoparium</i>	16	17
<i>Abies lasiocarpa</i> / <i>Carex geyeri</i>	22	5

¹Based on 125 m² per stand

The production of undergrowth vegetation in relation to habitat types needs to be examined. Ellison and Houston (1958), working in Utah, suggested that production of vegetation under *Populus tremuloides* could be used as an indicator of forage production and, therefore, range condition. In the White River National Forest, both cattle and sheep utilize, sometimes quite heavily, vegetation under *Populus*. It would be valuable to know the relationship between habitat types and potential undergrowth productivity.

The growth rates of important timber trees may correlate with habitat types similar to the relationship of growth rates of *Pinus ponderosa* and the habitat types in the northern Rocky Mountains described by Daubenmire (1961).

Numerous fungi attack *Populus tremuloides* in Colorado (Juzwik et al. 1978). Some *Populus* habitat types may be more susceptible to various species of fungi than others are. In northern Idaho and eastern Washington, *Arceuthobium* infects *Pinus ponderosa* in the *Pinus ponderosa*/*Agropyron spicatum* and *Pinus ponderosa*/*Purshia tridentata* habitat types, but not in other habitat types dominated by *Pinus ponderosa* (Daubenmire 1961). Susceptibility of *Picea engelmannii* to insect infestation may be correlated with habitat types in Colorado (Shepherd 1959).

The relationship of forest habitat types and their successional stages to wildlife management also needs further research.

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Appendix

Table A-1.—Tree population structures for each habitat type. Numbers of trees listed are based on sample plot data for 375 m² per stand

Habitat type and species	Stands sampled	Mean basal area	Diameter (d.b.h.) classes in dm									
			0.1		1-2	2-3	3-4	4-5	5-6	7-7	>8	
			<0.5	>0.5								
	number	m ² /ha number of trees									
<i>Pseudotsuga menziesii</i>												
<i>Pachistima myrsinites</i>	2	30.9										
<i>Pseudotsuga menziesii</i>			18	6	21	12	2					
<i>Picea engelmannii</i>			2									
<i>Abies lasiocarpa</i>					(¹)							
<i>Juniperus scopulorum</i>			8	2	1							
<i>Populus tremuloides</i> ¹												
<i>Symphoricarpos oreophilus</i>	8	41.8										
<i>Populus tremuloides</i>			83	29	20	10	7	2	(¹)			
<i>Abies lasiocarpa</i>				(¹)								
<i>Populus tremuloides</i> ¹												
<i>Thalictrum fendleri</i>	12	49.2										
<i>Populus tremuloides</i>			175	14	12	12	7	1	(¹)	(¹)		
<i>Abies lasiocarpa</i>			(¹)	(¹)								
<i>Populus tremuloides</i> ¹												
<i>Pteridium aquilinum</i>	1	29.3										
<i>Populus tremuloides</i>			240	9	6	7	6					
<i>Populus tremuloides</i> ¹												
<i>Heracleum sphondylium</i>	2	36.5										
<i>Populus tremuloides</i>			124	10	—	9	7	2				
<i>Populus tremuloides</i> ¹												
<i>Carex geyeri</i>	4	37.4										
<i>Populus tremuloides</i>			193	5	19	13	4					
<i>Abies lasiocarpa</i>				(¹)								
<i>Abies lasiocarpa</i> ¹												
<i>Carex geyeri</i>	5	58.7										
<i>Abies lasiocarpa</i>			87	10	5	1	(¹)	(¹)		(¹)		
<i>Picea engelmannii</i>			9	2	3	1	3	4	1	(¹)	(¹)	(¹)
<i>Populus tremuloides</i>			6	2	5	5	2	(¹)				
<i>Abies lasiocarpa</i> ¹												
<i>Vaccinium scoparium</i>	17	54.3										
<i>Abies lasiocarpa</i>			103	5	5	2	1	(¹)				
<i>Picea engelmannii</i>			21	2	5	2	1	1	1	(¹)	(¹)	
<i>Pinus contorta</i>			3	3	6	8	3	1				
<i>Populus tremuloides</i>			(¹)	(¹)	2	1						

¹Species with less than 1 per d.b.h. class.

Table A-2.—Location, topographic position, coverage (percent), and frequency (percent) of undergrowth species in stands of the *Pseudotsuga menziesii*/*Pachistima myrsinites* habitat type

	Stand number	
	36	57
Location		
Section	17	20
Township	8S	8S
Range	83W	83W
Topographic position		
Slope (%)	56	64
Aspect (°)	266	290
Elevation (m)	2560	2697
Coverage¹/Frequency		
Shrubs		
<i>Acer glabrium</i>	1.1/8	—
<i>Amelanchier alnifolia</i>	—	0.8/6
<i>Clematis pseudoalpina</i>	—	1.5/10
<i>Juniperus communis</i>	+ /2	3.1/16
<i>Juniperus scopulorum</i>	—	2.1/4
<i>Mahonia repens</i>	—	3.0/28
<i>Pachistima myrsinites</i>	35.0/88	21.0/76
<i>Ramischia secunda</i>	+ /2	—
<i>Rosa</i> sp.	3.2/30	3.8/28
<i>Shepherdia canadensis</i>	+ /2	1.4/8
<i>Symphoricarpos oreophilus</i>	1.7/8	4.6/20
Graminoids		
<i>Calamagrostis rubescens</i>	0.5/10	—
<i>Carex geyeri</i>	2.1/12	2.6/20
<i>Poa</i> spp.	+ /2	—
Forbs		
<i>Antennaria microphylla</i>	+ /6	—
<i>Aquilegia caerulea</i>	1.1/20	—
<i>Arnica cordifolia</i>	1.4/10	+ /4
<i>Epilobium angustifolium</i>	+ /2	0.5/6
<i>Fragaria</i> sp.	+ /2	+ /2
<i>Galium boreale</i>	—	0.9/10
<i>Lathyrus leucanthus</i>	+ /2	—
Mosses + Lichens	14.0/56	27.0/78
<i>Osmorhiza depauperata</i>	+ /2	+ /2
<i>Pseudocymopterus montanus</i>	+ /8	—
<i>Senecio wootonii</i>	0.8/8	—
<i>Smilacina racemosa</i>	—	+ /4
<i>Solidago multiradiata</i>	1.6/16	+ /6
<i>Solidago spathulata</i>	—	0.5/6

¹ + indicates coverage of less than 0.5%.

Table A-3.—Location, topographic position, coverage (percent), and frequency (percent) of undergrowth species in stands of the *Populus tremuloides*/*Symphoricarpos oreophilus*, *Populus tremuloides*/*Heracleum sphondylium*, and *Populus tremuloides*/*Carex geyeri* habitat types

	Stand number													
	<i>Populus</i> / <i>Symphoricarpos</i> H.T.							<i>Populus</i> / <i>Heracleum</i> H.T.			<i>Populus</i> / <i>Carex</i> H.T.			
	4	10	49	6	7	37	38	19	35	54	25	26	27	41
	6 4S 91W	34 3S 92W	32 1S 91W	11 11S 89W	11 11S 89W	8 8S 83W	5 8S 83W	24 5S 82W	30 4S 90W	17 7S 83W	14 8S 83W	14 8S 83W	10 8S 83W	26 6S 83W
Location														
Section	6	34	32	11	11	8	5	24	30	17	14	14	10	26
Township	4S	3S	1S	11S	11S	8S	8S	5S	4S	7S	8S	8S	8S	6S
Range	91W	92W	91W	89W	89W	83W	83W	82W	90W	83W	83W	83W	83W	83W
Topographic position														
Slope (%)	25	—	—	—	—	34	30	30	22	42	38	38	30	43
Aspect (°)	85	—	—	—	—	266	82	66	156	154	174	176	180	170
Elevation (m)	2652	2752	2667	2774	2774	2758	2858	2591	2713	2957	2975	2975	3033	2972
Coverage/Frequency														
Shrubs														
<i>Amelanchier alnifolia</i>	—	5.7/20	—	—	—	—	1.2/10	5.8/34	—	—	+ /6	+ /2	—	2.5/4
<i>Abies lasiocarpa</i>	—	—	—	3.7/6	—	—	—	—	—	—	—	—	—	—
<i>Mahonia repens</i>	—	—	—	—	—	—	—	3.2/16	—	—	—	+ /2	0.5/8	—
<i>Pachistima myrsinites</i>	—	—	—	—	—	—	2.9/8	—	—	—	1.1/8	—	+ /2	—
<i>Populus tremuloides</i>	—	—	—	3.2/12	+ /2	2.1/16	—	—	1.1/8	0.5/8	8.3/28	—	—	—
<i>Prunus virginiana</i>	—	+ /2	—	—	—	—	—	7.5/32	—	—	—	—	—	7.4/12
<i>Rosa</i> sp.	—	0.5/8	—	—	1.7/8	7.1/36	3.0/22	5.4/30	—	—	4.5/36	8.1/38	1.7/18	—
<i>Salix scouleriana</i>	—	—	—	—	—	—	—	—	—	—	—	—	+ /2	—
<i>Sambucus racemosa</i>	—	—	—	—	—	—	+ /2	0.6/4	—	—	—	—	—	—
<i>Sorbus scopulina</i>	—	—	—	2.2/4	+ /2	—	—	0.6/4	8.0/30	—	—	—	—	—
<i>Symphoricarpos oreophilus</i>	30.0/82	35.0/70	7.0/32	34.0/70	29.0/78	23.0/52	22.0/48	6.2/12	2.1/2	1.6/2	2.1/10	—	—	0.7/8
Graminoids														
<i>Bromus anomalus</i>	—	—	0.6/6	—	—	—	—	1.3/12	—	—	—	—	—	—
<i>Bromus ciliatus</i>	2.3/16	1.7/18	18.0/76	—	—	+ /6	2.3/18	8.4/54	20.0/80	8.0/32	4.6/40	1.1/8	0.8/6	2.6/24
<i>Calamagrostis rubescens</i>	3.5/8	—	—	—	—	—	—	—	—	—	—	—	—	3.0/8
<i>Carex geyeri</i>	27.0/62	30.0/92	25.0/68	46.0/86	36.0/100	49.0/100	39.0/100	43.0/96	—	32.0/80	39.0/98	40.0/100	29.0/96	42.0/92
<i>Elymus glaucus</i>	3.3/20	9.6/40	1.9/16	5.1/42	9.6/62	1.4/18	6.6/26	21.0/78	6.7/40	3.6/12	11.0/68	6.8/30	2.3/20	14.0/60
<i>Festuca thurberi</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	2.3/6
<i>Melica spectabilis</i>	+ /2	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Poa interior</i>	4.2/26	—	+ /4	—	—	—	—	—	3.1/18	—	+ /2	12.0/38	4.8/20	—
<i>Poa nevadensis</i>	—	—	—	—	—	—	—	—	—	—	—	—	2.3/12	—
<i>Poa pratensis</i>	4.6/22	—	—	—	—	—	—	—	—	—	—	10.0/24	—	+ /2
Forbs														
<i>Achillea millefolium</i>	9.4/60	4.8/36	1.9/16	—	—	3.6/26	—	1.2/26	1.4/10	+ /6	4.3/50	5.4/42	4.8/36	1.0/20
<i>Agastache urticifolia</i>	4.8/16	—	0.7/8	—	—	—	—	—	—	—	—	—	—	—
<i>Aquilegia caerulea</i>	—	1.1/8	—	4.9/20	1.4/8	+ /4	—	—	2.5/16	0.6/10	—	—	—	—
<i>Arnica cordifolia</i>	—	—	—	—	—	—	—	+ /8	—	—	6.6/64	2.9/28	6.9/58	—
<i>Arnica parryi</i>	—	—	12.0/44	—	—	—	—	—	—	—	—	—	—	—
<i>Aster engelmannii</i>	—	1.1/20	—	2.7/36	2.9/18	8.0/52	6.4/20	1.5/4	0.2/8	+ /4	—	—	2.8/28	—
<i>Castilleja sulphurea</i>	—	—	—	—	—	3.1/18	0.8/8	—	—	—	—	—	1.6/14	0.7/8
<i>Chenopodium atrovirens</i>	0.5/10	—	—	—	—	—	—	—	+ /2	+ /2	—	—	—	—
<i>Cirsium</i> sp.	0.9/4	—	3.4/20	+ /4	—	—	1.2/10	2.3/32	1.7/8	—	—	—	—	10.0/40
<i>Clematis pseudoalpina</i>	—	—	—	—	—	—	—	0.6/4	—	—	—	—	—	—
<i>Collomia linearis</i>	—	—	—	—	—	—	—	0.7/8	—	+ /2	—	—	—	—
<i>Delphinium barbeyi</i>	—	+ /2	—	+ /6	—	5.8/20	+ /2	—	—	+ /2	—	—	—	—
<i>Descurainia californica</i>	0.8/6	—	—	—	—	—	—	—	+ /2	+ /2	—	—	—	—
<i>Dugaldia hoopesii</i>	7.8/36	+ /2	—	—	—	3.6/12	21.0/58	—	—	—	2.1/22	+ /2	—	+ /4
<i>Epilobium angustifolium</i>	—	—	—	—	—	+ /2	2.4/22	1.9/16	—	3.6/32	+ /4	0.5/8	+ /2	0.7/8
<i>Erigeron elatior</i>	0.8/6	—	—	+ /4	1.1/8	—	2.3/18	—	—	+ /2	—	0.8/6	—	—
<i>Erigeron speciosus</i>	—	—	—	—	—	+ /2	—	—	—	—	—	—	+ /2	—
<i>Fragaria</i> sp.	2.0/18	—	5.5/28	4.8/48	+ /6	1.4/18	1.4/18	2.1/46	—	—	3.9/42	+ /18	16.0/72	36.0/88
<i>Galium aparine</i>	—	—	—	—	—	—	—	7.5/24	—	—	—	—	—	—
<i>Galium boreale</i>	2.9/28	2.1/26	0.8/12	1.5/22	2.5/38	+ /12	+ /10	+ /4	—	—	—	—	—	—
<i>Geranium caespitosum</i>	0.5/8	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Geranium richardsonii</i>	2.7/12	0.9/10	32.0/96	0.9/26	+ /2	2.8/28	2.8/40	1.3/12	4.5/32	23.0/70	—	—	—	+ /8
<i>Heracleum sphondylium</i>	—	—	—	—	—	+ /2	—	—	67.0/92	48.0/90	—	—	—	—
<i>Hydrophyllum capitatum</i>	+ /2	—	0.9/20	—	—	—	—	—	—	—	—	—	—	—
<i>Lathyrus leucanthus</i>	14.0/58	13.0/66	2.5/20	25.0/78	23.0/88	12.0/50	15.0/68	4.8/24	—	—	13.0/56	18.0/86	24.0/82	15.0/52
<i>Ligusticum porteri</i>	0.8/6	2.0/8	—	5.0/10	5.0/12	8.2/28	8.8/30	—	—	—	—	—	—	—
<i>Lupinus argenteus</i>	—	16.0/60	—	+ /2	—	6.7/30	+ /2	+ /8	—	—	+ /6	—	7.0/60	—
<i>Mertensia ciliata</i>	—	—	—	0.6/12	+ /2	—	—	—	—	—	—	—	—	—
<i>Nemophila breviflora</i>	5.0/30	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Osmorhiza occidentalis</i>	—	—	0.6/6	—	—	1.2/8	—	+ /2	—	2.3/12	—	—	—	—
<i>Osmorhiza</i> sp.	0.8/6	8.2/66	9.3/44	12.0/62	3.3/32	—	—	3.4/58	35.0/62	+ /2	—	—	—	—
<i>Pedicularis procera</i>	—	+ /2	—	—	—	—	—	—	—	—	—	—	—	—
<i>Penstemon strictus</i>	—	—	—	1.6/12	—	—	—	—	—	—	—	—	—	—
<i>Potentilla gracilis</i>	+ /2	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Pseudocymopterus montanus</i>	—	—	—	—	—	—	—	—	—	—	+ /2	+ /2	—	—
<i>Polemonium caeruleum</i>	—	—	—	0.8/4	—	—	—	—	0.8/4	—	—	—	—	—
<i>Rudbeckia laciniata</i>	—	—	6.7/20	—	—	—	—	—	—	—	—	—	—	—
<i>Senecio serra</i>	—	—	13.0/40	1.4/18	—	+ /2	—	—	3.3/12	8.2/30	—	—	—	+ /8
<i>Smilacina racemosa</i>	4.0/18	—	—	—	1.1/8	—	—	—	—	—	2.3/30	2.0/18	+ /2	—
<i>Stellaria jamesiana</i>	12.0/68	0.8/8	2.7/28	—	—	+ /2	+ /2	—	10.0/58	—	—	—	—	—
<i>Streptopus amplexifolius</i>	—	+ /2	—	—	—	—	—	—	—	—	—	—	—	—
<i>Taraxacum</i> sp.	1.9/16	+ /2	0.7/8	3.6/42	0.8/8	+ /6	+ /6	0.7/8	—	—	—	+ /2	—	5.4/40
<i>Thalictrum fendleri</i>	11.0/42	23.0/66	25.0/80	12.0/40	31.0/80	37.0/88	27.0/92	4.4/12	14.0/42	43.0/96	20.0/58	13.0/52	1.1/8	11.0/24
<i>Thlaspi montanum</i>	—	—	1.2/12	—	—	—	—	—	—	—	—	—	—	—
<i>Valeriana occidentalis</i>	—	+ /2	—	+ /8	1.4/18	1.2/10	—	+ /4	—	—	—	—	—	—
<i>Vicia americana</i>	4.8/32	5.3/30	0.7/8	13.0/68	22.0/86	15.0/58	27.0/80	2.9/24	—	29.0/78	30.0/88	18.0/76	6.8/32	32.0/92
<i>Viola canadensis</i>	4.9/48	+ /10	—	1.2/22	+ /6	—	—	+ /2	—	—	2.5/26	—	—	—
<i>Viola nuttallii</i>	—	—	—	—	—	—	—	+ /4	—	1.2/10	—	—	—	—

¹ + indicates coverage of less than 0.5%.

Table A-4.—Location, topographic position, coverage (percent), and frequency (percent) of undergrowth species in the *Populus tremuloides*/*Thalictrum fendleri* and *Populus tremuloides*/*Pteridium aquilinum* habitat types

	Stand number												
	<i>Populus/Thalictrum</i> H.T.												<i>Populus/Pteridium</i> H.T.
	2	3	11	16	34	24	15	5	53	39	40	18	14
Location													
Section	33	24	20	30	32	23	2	21	17	30	25	25	1
Township	3S	3S	3S	3S	3S	8S	11S	7S	7S	4S	4S	5S	11S
Range	92W	93W	92W	92W	90W	90W	89W	83W	83W	87W	88W	82W	89W
Topographic position													
Slope (%)	15	—	20	8	17	30	10	40	40	—	10	15	—
Aspect (°)	58	—	50	120	106	114	166	186	166	—	150	346	—
Elevation (m)	2736	2858	2781	2682	2957	2877	2560	2865	3002	3033	3048	2819	2682
Coverage/Frequency													
Shrubs													
<i>Abies lasiocarpa</i>	—	—	—	—	—	—	—	—	4.8/6	—	—	—	—
<i>Amelanchier alnifolia</i>	—	—	—	—	—	—	3.6/12	—	—	—	—	—	—
<i>Pachistima myrsinites</i>	—	—	+ /4	—	—	—	—	+ /2	—	—	—	—	—
<i>Populus tremuloides</i>	3.9/35	—	+ /2	1.3/16	+ /2	—	—	—	+ /6	4.8/24	—	+ /4	5.8/28
<i>Rosa</i> sp.	—	—	+ /6	0.7/8	—	—	1.3/12	—	—	—	—	—	—
<i>Rubus parviflorus</i>	—	—	—	—	—	—	—	—	—	—	—	2.0/8	—
<i>Sambucus racemosa</i>	—	—	—	—	—	+ /2	—	—	—	—	—	2.0/8	—
<i>Symphoricarpos oreophilus</i>	7.3/22	3.7/12	6.1/20	9.3/23	—	—	14.0/40	—	—	—	—	—	5.3/18
Graminoids													
<i>Bromus anomalus</i>	—	—	—	2.3/10	—	1.8/8	3.7/10	—	—	—	2.9/12	3.0/22	—
<i>Bromus ciliatus</i>	7.8/72	5.6/62	4.3/22	16.0/74	1.8/12	11.0/70	—	+ /2	9.1/36	0.8/12	1.2/8	5.1/50	1.5/10
<i>Calamagrostis rubescens</i>	—	—	+ /2	—	—	—	—	—	—	—	—	—	1.0/6
<i>Carex geyeri</i>	4.7/20	6.5/22	20.0/72	19.0/80	—	0.7/4	59.0/92	30.0/80	41.0/92	25.0/60	2.7/12	24.0/74	4.9/28
<i>Carex</i> spp.	—	—	—	—	—	—	—	—	—	—	—	—	+ /2
<i>Elymus glaucus</i>	8.0/52	5.2/40	27.0/88	7.8/50	7.2/60	+ /4	16.0/70	1.9/6	+ /2	9.9/32	0.7/8	11.0/62	7.9/40
<i>Melica spectabilis</i>	—	1.1/24	—	—	5.2/42	2.4/10	—	—	—	—	—	—	—
<i>Poa agassizensis</i>	—	—	—	+ /4	—	—	+ /8	—	—	—	—	+ /6	—
<i>Poa leptocoma</i>	—	+ /2	—	—	—	—	+ /4	—	—	—	—	—	—
<i>Poa pratensis</i>	—	—	—	—	—	+ /4	—	—	0.9/6	—	—	+ /2	—
<i>Poa trivialis</i>	—	—	—	—	—	—	—	—	—	—	—	+ /2	—
Forbs													
<i>Achillea millefolium</i>	—	+ /2	—	7.5/42	—	—	+ /8	—	—	—	—	3.2/50	2.9/28
<i>Actaea rubra</i>	—	—	—	—	—	—	—	—	—	—	—	—	0.9/4
<i>Agastache urticifolia</i>	+ /2	—	—	—	3.2/12	—	—	—	—	—	—	—	—
<i>Androsace septentrionalis</i>	—	—	—	—	+ /2	—	—	—	—	—	—	—	—
<i>Aquilegia caerulea</i>	0.8/8	+ /4	0.7/6	—	2.2/26	+ /4	—	1.7/10	—	+ /12	+ /10	—	—
<i>Arnica cordifolia</i>	—	—	—	—	—	—	—	—	—	—	—	+ /16	—
<i>Arnica parryi</i>	—	—	—	—	—	+ /4	—	—	+ /2	—	—	—	—
<i>Aster engelmannii</i>	4.0/18	3.6/26	6.3/50	—	5.3/10	2.5/16	3.1/46	+ /2	0.9/12	2.3/16	—	+ /4	3.8/20
<i>Castilleja sulphurea</i>	—	—	—	—	—	—	—	—	—	—	—	0.9/16	—
<i>Cerastium arvense</i>	—	+ /2	—	—	—	—	—	—	—	—	—	—	—
<i>Chenopodium atrovirens</i>	—	+ /2	—	—	—	—	+ /4	—	—	—	—	—	—
<i>Cirsium</i> sp.	+ /6	+ /4	+ /2	0.7/8	3.4/38	+ /6	—	—	—	—	+ /4	2.5/24	+ /2
<i>Collomia linearis</i>	—	—	+ /2	—	—	—	—	—	—	—	—	—	—
<i>Delphinium barbeyi</i>	0.7/6	—	0.6/14	—	—	0.8/6	—	—	1.1/8	—	18.0/36	—	1.4/10
<i>Descurainia californica</i>	—	—	—	0.7/8	—	—	—	—	—	—	—	—	—
<i>Draba</i> sp.	—	1.1/14	—	—	—	—	—	—	—	—	—	—	—
<i>Dugaldia hoopesii</i>	—	3.7/14	—	—	4.8/28	—	—	0.6/4	—	0.6/4	—	—	—
<i>Epilobium angustifolium</i>	+ /2	0.9/6	+ /2	3.3/20	—	—	—	12.0/52	20.0/86	—	1.4/16	0.6/4	0.4/6
<i>Erigeron elatior</i>	—	0.7/6	—	—	—	—	—	0.9/8	—	+ /4	0.6/4	3.4/24	+ /4
<i>Erigeron speciosus</i>	—	—	+ /4	—	—	0.5/6	—	—	—	—	—	+ /4	—
<i>Fragaria</i> sp.	+ /6	3.3/32	1.3/14	—	—	+ /2	+ /8	+ /6	—	+ /8	—	6.7/80	4.8/42
<i>Galium aparine</i>	—	—	—	—	+ /4	—	—	—	—	—	—	—	—
<i>Galium boreale</i>	0.9/10	0.9/6	0.8/20	4.4/62	—	2.9/30	0.6/24	—	—	—	—	4.6/70	5.1/68
<i>Geranium richardsonii</i>	4.8/32	3.2/24	11.0/62	4.4/46	—	0.6/10	—	34.0/90	25.0/75	8.8/64	0.9/16	11.0/58	3.9/38
<i>Heracleum sphondylium</i>	7.7/45	+ /2	+ /2	0.6/4	—	10.0/50	—	8.2/28	11.0/28	—	—	—	8.2/20
<i>Hydrophyllum capitatum</i>	2.9/20	5.6/30	2.1/12	—	+ /2	15.0/60	—	—	—	—	—	—	—
<i>Hydrophyllum fendleri</i>	3.6/24	—	—	—	—	—	+ /2	—	—	—	+ /4	—	—
<i>Lathyrus leucanthus</i>	15.0/48	2.5/14	10.0/42	9.0/46	6.6/36	0.8/8	3.7/32	22.0/70	2.6/12	32.0/80	0.8/12	14.0/70	9.0/48
<i>Ligusticum porteri</i>	—	60.0/90	12.0/20	—	26.0/60	27.0/58	8.8/28	—	—	50.0/72	52.0/76	—	—
<i>Lupinus argenteus</i>	1.9/16	2.6/18	7.4/46	0.6/16	—	—	10.0/54	1.3/22	—	9.0/56	18.0/72	—	5.5/46
<i>Mertensia ciliata</i>	—	—	—	—	—	—	—	—	—	—	—	—	+ /2
<i>Nemophila breviflora</i>	—	—	—	—	+ /2	9.0/42	—	—	—	—	—	—	—
<i>Osmorhiza occidentalis</i>	—	—	5.9/20	5.1/34	—	—	5.7/28	—	—	—	—	2.0/18	1.3/6
<i>Osmorhiza</i> sp.	15.0/52	17.0/44	4.4/26	13.0/70	36.0/78	25.0/80	8.8/54	—	—	0.6/4	26.0/64	5.0/66	13.0/50
<i>Pedicularis bracteosa</i>	—	+ /2	0.6/4	—	—	—	—	—	—	18.0/32	—	—	—
<i>Pedicularis procera</i>	+ /2	—	—	—	—	—	—	1.0/12	1.3/6	—	—	—	—
<i>Penstemon whippleanus</i>	—	—	—	+ /2	—	—	—	—	—	—	—	—	—
<i>Phacelia heterophylla</i>	—	—	—	+ /4	—	—	—	—	—	—	—	—	—
<i>Polemonium caeruleum</i>	—	—	—	—	—	5.1/18	—	—	—	—	—	—	+ /2
<i>Potentilla gracilis</i>	—	—	—	—	—	—	—	—	—	—	—	—	+ /4
<i>Pteridium aquilinum</i>	—	—	—	—	—	—	—	—	—	—	—	—	78.0/96
<i>Rudbeckia laciniata</i>	—	—	7.1/34	—	—	—	—	—	—	—	—	—	4.3/22
<i>Senecio crassulus</i>	—	—	—	7.0/42	—	—	—	1.3/10	—	—	—	—	—
<i>Senecio serra</i>	—	—	+ /2	1.0/20	3.6/22	+ /6	—	2.1/8	3.8/20	4.1/28	8.0/38	2.4/24	+ /2
<i>Smilacina racemosa</i>	0.7/6	—	—	—	—	—	—	0.9/6	5.7/28	—	—	—	0.9/4
<i>Smilacina stellata</i>	—	—	—	+ /8	—	—	—	—	—	—	—	—	—
<i>Solidago spatulata</i>	—	—	—	—	—	—	—	—	—	—	—	3.6/32	—
<i>Stellaria jamesiana</i>	17.0/78	12.0/70	5.4/60	4.3/42	12.0/92	4.3/28	—	—	+ /2	1.1/24	9.0/64	—	—
<i>Streptopus amplexifolius</i>	—	—	—	—	—	—	—	—	—	—	—	—	+ /4
<i>Taraxacum</i> sp.	—	—	+ /2	+ /8	—	—	0.7/8	+ /2	+ /2	—	—	0.9/16	2.1/22
<i>Thalictrum fendleri</i>	21.0/58	6.6/24	45.0/88	18.0/54	19.0/48	1.9/8	36.0/92	24.0/64	37.0/100	21.0/68	59.0/88	7.1/12	8.5/18
<i>Thlaspi montanum</i>	—	—	—	—	0.5/8	—	—	—	—	—	+ /4	—	—
<i>Trillium ovatum</i>	—	—	—	—	+ /8	4.0/36	—	—	—	—	—	—	—
<i>Valeriana occidentalis</i>	0.7/6	4.0/16	3.2/24	—	6.3/25	9.2/36	+ /4	4.1/24	+ /2	1.3/12	1.2/8	—	+ /2
<i>Veratrum tenuipetalum</i>	—	—	—	—	—	0.5/6	—	—	—	—	—	—	—
<i>Vicia americana</i>	3.1/16	1.0/8	4.9/30	8.8/54	—	+ /2	32.0/70	14.0/64	25.0/70	30.0/64	—	9.4/58	8.1/36
<i>Viola canadensis</i>	—	—	—	—	—	—	—	1.3/10	0.9/10	—	—	—	1.9/28
<i>Viola nuttallii</i>	—	0.7/8	—	0.5/20	—	+ /2	0.6/4	7.1/60	4.8/58	5.5/48	1.4/36	—	2.8/24
<i>Wyethia amplexicaulis</i>	—	—	—	—	—	—	—	—	—	0.6/4	—	—	—

¹ + indicates coverage of less than 0.5%.

Table A-5.—Location, topographic position, coverage (percent), and frequency (percent) of undergrowth species in the *Abies lasiocarpa*/*Vaccinium scoparium* habitat type

	Stand number																
	9	50	51	1	55	12	28	13	42	22	23	47	46	52	21	20	45
Location																	
Section	12	21	5	8	21	25	15	31	23	3	1	14	20	30	17	17	2
Township	11S	9S	9S	9S	8S	8S	8S	8S	8S	6S	8S	4S	4S	4S	4S	4S	6S
Range	89W	84W	84W	84W	82W	82W	83W	82W	83W	80W	80W	81W	81W	80W	81W	81W	80W
Topographic position																	
Slope (%)	25	40	—	12	33	27	38	30	12	27	19	20	20	25	35	12	15
Aspect (°)	320	286	—	292	178	196	326	190	273	286	86	286	4	292	326	26	181
Elevation (m)	2743	2972	3048	3231	2896	2972	3050	3078	2941	3261	3414	2896	2957	3048	3063	3078	3353
Coverage/Frequency																	
Shrubs																	
<i>Abies lasiocarpa</i>	8.4/28	0.8/12	5.5/12	3.6/20	—	—	—	—	1.6/6	—	6.2/16	4.4/24	—	—	—	+ /2	+ /2
<i>Juniperus communis</i>	—	2.4/4	—	—	—	—	—	0.7/2	2.0/8	—	—	—	—	—	—	—	—
<i>Mahonia repens</i>	—	—	—	—	+ /2	0.8/4	—	+ /4	—	—	—	—	—	—	—	—	—
<i>Pachistima myrsinites</i>	+ /6	12.0/56	—	—	+ /8	0.8/14	+ /2	0.5/10	3.1/28	—	+ /6	+ /4	1.0/20	0.8/10	+ /6	—	—
<i>Picea engelmannii</i>	—	2.1/8	—	1.8/6	—	—	+ /2	—	—	—	+ /4	—	—	—	—	—	—
<i>Ramischia secunda</i>	—	0.6/4	—	—	—	—	0.9/10	—	0.9/10	2.4/20	+ /2	—	+ /12	—	1.6/14	+ /2	—
<i>Rosa sp.</i>	—	—	—	—	1.7/28	1.8/34	0.5/8	4.6/42	+ /2	—	—	—	—	—	—	—	—
<i>Rubus parviflorus</i>	+ /2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Shepherdia canadensis</i>	—	—	—	—	—	4.9/10	—	14.0/26	—	—	+ /4	—	4.0/8	—	—	—	—
<i>Sorbus scopulina</i>	—	—	—	+ /2	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Symphoricarpos oreophilus</i>	0.9/4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Vaccinium cespitosum</i>	—	—	—	—	—	—	+ /2	—	—	—	1.7/12	—	—	—	—	—	—
<i>Vaccinium myrtilloides</i>	2.1/12	—	0.7/6	16.0/50	—	0.6/4	7.4/52	+ /2	11.0/72	1.7/12	19.0/76	6.8/56	1.3/12	1.5/20	11.0/72	7.5/42	11.0/68
<i>Vaccinium scoparium</i>	15.0/58	49.0/92	77.0/100	30.0/72	30.0/76	21.0/88	42.0/98	28.0/80	12.0/78	5.2/32	25.0/82	70.0/100	34.0/88	43.0/100	37.0/98	35.0/96	60.0/100
Graminoids																	
<i>Bromus ciliatus</i>	+ /4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Calamagrostis inexpectata</i>	—	+ /4	—	—	—	—	—	—	+ /2	0.7/8	—	—	—	—	—	—	—
<i>Carex geyeri</i>	+ /2	—	6.4/40	1.4/8	9.8/44	0.7/2	—	+ /8	—	0.6/6	13.0/46	—	—	—	+ /2	5.4/32	23.0/64
<i>Elymus glaucus</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+ /4	—
<i>Poa nemoralis</i>	—	—	—	—	+ /2	—	—	—	—	+ /4	—	—	0.5/14	—	—	—	—
<i>Poa nervosa</i>	+ /2	—	—	—	—	—	+ /6	—	—	—	—	—	2.7/28	—	—	—	+ /4
<i>Poa pratensis</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+ /4	—	—
Forbs																	
<i>Achillea millefolium</i>	—	—	—	+ /2	—	—	—	+ /2	—	—	—	—	—	—	—	—	—
<i>Antennaria microphylla</i>	—	—	—	—	—	+ /2	—	—	—	—	—	—	—	—	—	—	—
<i>Arnica cordifolia</i>	5.5/50	9.0/56	0.6/8	0.7/18	0.6/6	3.6/32	1.0/18	1.0/22	12.0/66	14.0/88	+ /2	3.0/36	—	5.7/36	1.1/24	10.0/58	21.0/64
<i>Arnica latifolia</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4.4/24
<i>Aster engelmannii</i>	0.9/10	—	—	—	—	—	—	—	—	—	—	—	2.9/36	—	—	+ /2	—
<i>Campanula rotundifolia</i>	—	—	—	—	—	+ /8	—	—	—	—	—	—	—	—	—	+ /2	—
<i>Castilleja calyptrata</i>	—	—	—	—	—	—	—	—	+ /2	—	—	—	—	—	—	—	—
<i>Epilobium angustifolium</i>	—	0.9/16	—	+ /4	—	+ /2	+ /6	+ /2	+ /2	—	—	+ /4	—	—	—	0.9/6	—
<i>Erigeron pinnatifidus</i>	—	0.6/4	—	—	—	—	—	+ /4	—	—	+ /2	—	—	—	—	+ /2	—
<i>Fragaria sp.</i>	—	—	—	+ /4	—	—	+ /2	1.9/28	—	0.7/8	—	—	—	—	—	—	—
<i>Galium boreale</i>	1.1/18	—	—	—	—	+ /2	—	—	—	+ /2	—	—	+ /2	—	—	—	—
<i>Hieracium albiflorum</i>	—	—	—	+ /2	0.8/12	+ /6	—	—	—	—	—	—	—	—	—	+ /2	—
<i>Lathyrus laucanthus</i>	—	5.3/40	—	—	—	—	—	—	11.0/30	—	—	0.8/12	8.7/44	6.0/48	3.2/28	8.0/40	—
<i>Ligusticum porteri</i>	—	—	—	—	—	—	—	—	—	2.1/14	—	—	—	—	—	—	—
<i>Lupinus argenteus</i>	—	0.8/12	—	4.5/32	—	—	+ /2	—	—	—	4.9/32	—	5.1/68	—	—	—	1.2/8
<i>Mertensia ciliata</i>	—	—	—	—	—	—	—	—	—	5.6/28	—	—	—	—	—	—	—
Mosses + Lichens	1.0/18	—	1.9/18	10.0/36	1.1/24	+ /4	7.4/40	—	+ /10	5.8/20	1.5/10	20.0/64	5.6/32	5.0/48	16.0/52	+ /2	0.8/12
<i>Osmorhiza depauperata</i>	+ /8	—	—	+ /2	—	—	—	+ /2	—	4.6/28	—	—	—	—	—	—	—
<i>Pedicularis racemosa</i>	—	+ /12	11.0/44	—	—	—	—	—	—	+ /2	11.0/38	+ /2	+ /12	—	0.7/6	+ /2	8.2/24
<i>Polanomonium caeruleum</i>	—	—	—	+ /2	—	—	—	—	—	1.3/12	—	—	—	—	—	+ /2	—
<i>Potentilla gracilis</i>	—	+ /2	—	—	—	—	+ /4	—	—	+ /4	—	—	—	—	+ /4	—	—
<i>Pseudocymopterus montanus</i>	+ /2	—	—	—	+ /2	—	—	+ /4	—	—	—	+ /2	—	—	—	+ /2	—
<i>Senecio sarra</i>	—	—	—	—	—	+ /12	—	—	2.4/18	—	—	—	—	—	—	+ /2	—
<i>Senecio wootonii</i>	—	—	—	—	—	—	+ /6	—	—	—	—	—	+ /4	—	—	—	—
<i>Smilacina racemosa</i>	+ /2	0.6/8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Solidago multiradiata</i>	—	0.9/18	—	0.5/8	+ /4	2.8/34	—	2.1/26	3.4/30	—	—	—	+ /4	—	—	+ /8	—
<i>Solidago spathulata</i>	—	—	—	+ /4	—	—	—	+ /6	—	—	0.5/12	—	—	—	—	—	+ /6
<i>Vicia americana</i>	—	—	—	—	—	—	—	—	0.8/20	—	—	—	0.4/16	1.2/24	—	2.2/30	—
<i>Viola nuttallii</i>	0.8/10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+ /4	—

+ indicates coverage of less than 0.5%.

Table A-6.—Location, topographic position, coverage (percent), and frequency (percent) of undergrowth species in the *Abies lasiocarpa*/*Carex geyeri* habitat type

	Stand number				
	48	17	43	44	8
Location					
Section	18	12	34	34	12
Township	3S	8S	8S	8S	11S
Range	91W	90W	90W	90W	89W
Topographic position					
Slope (%)	—	—	45	43	40
Aspect (°)	—	—	271	269	296
Elevation (m)	2850	2804	2941	2960	2713
Coverage/Frequency					
Shrubs					
<i>Abies lasiocarpa</i>	4.4/20	21.0/40	13.0/34	12.0/40	9.3/18
<i>Amelanchier alnifolia</i>	—	—	—	—	+ /2
<i>Lonicera involucrata</i>	6.3/10	—	—	—	—
<i>Pachistima myrsinites</i>	—	—	4.1/44	5.0/46	—
<i>Picea engelmannii</i>	—	—	—	+ /4	—
<i>Populus tremuloides</i>	—	—	—	—	+ /2
<i>Ramischia secunda</i>	2.4/16	—	+ /4	+ /8	—
<i>Ribes cereum</i>	+ /4	—	—	—	—
<i>Ribes montigenum</i>	—	—	+ /4	+ /2	—
<i>Rosa</i> sp.	—	—	—	—	+ /6
<i>Rubus idaeus</i>	2.4/6	—	—	—	—
<i>Rubus parviflorus</i>	16.0/48	—	—	—	4.6/30
<i>Symphoricarpos oreophilus</i>	—	—	—	—	21.0/58
<i>Vaccinium myrtillus</i>	—	—	0.7/8	—	—
<i>Vaccinium scoparium</i>	—	—	0.8/16	—	+ /2
Graminoids					
<i>Bromus ciliatus</i>	—	3.1/28	—	—	9.8/52
<i>Calamagrostis rubescens</i>	—	—	—	—	0.8/6
<i>Carex geyeri</i>	21.0/33	29.0/82	6.9/42	5.9/24	7.9/30
<i>Elymus glaucus</i>	—	1.7/30	—	—	—
<i>Melica spectabilis</i>	—	+ /4	—	—	—
<i>Poa nervosa</i>	+ /2	—	—	—	+ /6
Forbs					
<i>Achillea millefolium</i>	—	+ /4	—	—	+ /6
<i>Actaea rubra</i>	—	0.6/4	—	—	—
<i>Aquilegia caerulea</i>	—	0.5/18	+ /4	—	—
<i>Arnica cordifolia</i>	—	—	7.6/52	0.5/20	3.4/28
<i>Aster engelmannii</i>	2.8/30	0.6/4	0.7/8	5.2/36	11.0/58
<i>Cirsium</i> sp.	—	4.3/26	—	—	—
<i>Collomia linearis</i>	—	—	—	—	+ /4
<i>Delphinium barbeyi</i>	—	4.1/20	—	—	0.8/8
<i>Descurainia californica</i>	+ /2	—	—	—	—
<i>Epilobium angustifolium</i>	—	—	0.7/8	—	—
<i>Erigeron elatior</i>	0.5/10	—	—	—	—
<i>Erigeron speciosus</i>	—	0.9/16	—	—	—
<i>Fragaria</i> sp.	—	1.0/20	—	—	2.3/30
<i>Galium aparine</i>	1.3/8	—	—	—	—
<i>Galium boreale</i>	—	1.3/32	+ /4	+ /8	3.3/56
<i>Geranium richardsonii</i>	+ /4	3.3/54	+ /4	—	1.2/22
<i>Heracleum sphondylium</i>	—	1.2/12	—	—	—
<i>Hydrophyllum fendleri</i>	—	3.0/24	—	—	—
<i>Lathyrus leucanthus</i>	—	0.7/8	4.2/32	0.9/16	17.0/70
<i>Ligusticum porteri</i>	2.2/8	3.6/16	4.1/20	+ /4	0.8/8
<i>Lupinus argenteus</i>	—	—	—	—	2.2/6
Mosses + Lichens	—	—	2.4/28	5.0/28	—
<i>Osmorhiza depauperata</i>	5.2/44	2.0/18	0.4/16	0.3/18	—
<i>Osmorhiza</i> sp.	0.6/10	—	+ /8	—	+ /6
<i>Pedicularis racemosa</i>	1.3/6	—	0.5/4	2.2/12	—
<i>Polemonium caeruleum</i>	+ /2	—	—	—	—
<i>Potentilla gracilis</i>	—	+ /4	—	—	—
<i>Pseudocymopterus montanus</i>	—	—	—	+ /8	+ /8
<i>Ranunculus uncinatus</i>	—	—	—	—	+ /2
<i>Senecio serra</i>	0.5/4	+ /4	—	—	—
<i>Senecio wootonii</i>	—	5.1/24	—	—	—
<i>Smilacina racemosa</i>	+ /4	—	—	—	—
<i>Smilacina stellata</i>	—	4.0/20	—	—	—
<i>Solidago multiradiata</i>	—	—	0.8/12	+ /6	—
<i>Solidago spathulata</i>	—	+ /4	+ /2	—	—
<i>Stellaria jamesiana</i>	—	0.6/24	—	—	—
<i>Taraxacum</i> sp.	—	1.7/32	—	—	+ /4
<i>Thalictrum fendleri</i>	1.3/8	12.0/50	—	—	—
<i>Thlaspi montanum</i>	—	+ /8	—	—	—
<i>Trillium ovatum</i>	—	—	—	—	+ /2
<i>Valeriana occidentalis</i>	—	11.0/62	—	—	—
<i>Vicia americana</i>	—	+ /6	—	—	2.0/18
<i>Viola canadensis</i>	+ /8	4.5/50	—	—	0.9/10
<i>Viola nuttallii</i>	—	+ /4	—	—	—

¹ + indicates coverage of less than 0.5%.

Hoffman, George R., and Robert R. Alexander. 1983. Forest vegetation of the White River National Forest in western Colorado: A habitat type classification. USDA Forest Service Research Paper RM-249, 36 p. Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.

A vegetation classification based on concepts and methods developed by Daubenmire was used to identify eleven forest habitat types in the White River National Forest. Included were five habitat types in the *Populus tremuloides* series, two in the *Abies lasiocarpa* series, and one each in the *Pseudotsuga menziesii*, *Pinus edulis*, *Picea pungens*, and *Quercus gambelii* series. A key to identify the habitat types and the management implications associated with each is provided.

Keywords: Vegetation classification, habitat type, *Abies lasiocarpa*, *Picea engelmannii*, *Picea pungens*, *Pinus edulis*, *Pinus contorta*, *Populus tremuloides*, *Pseudotsuga menziesii*, *Quercus gambelii*.

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Rocky
Mountains



Southwest



Great
Plains

U.S. Department of Agriculture
Forest Service

Rocky Mountain Forest and Range Experiment Station

The Rocky Mountain Station is one of eight regional experiment stations, plus the Forest Products Laboratory and the Washington Office Staff, that make up the Forest Service research organization.

RESEARCH FOCUS

Research programs at the Rocky Mountain Station are coordinated with area universities and with other institutions. Many studies are conducted on a cooperative basis to accelerate solutions to problems involving range, water, wildlife and fish habitat, human and community development, timber, recreation, protection, and multiresource evaluation.

RESEARCH LOCATIONS

Research Work Units of the Rocky Mountain Station are operated in cooperation with universities in the following cities:

Albuquerque, New Mexico
Flagstaff, Arizona
Fort Collins, Colorado*
Laramie, Wyoming
Lincoln, Nebraska
Rapid City, South Dakota
Tempe, Arizona

*Station Headquarters: 240 W. Prospect St., Fort Collins, CO 80526